Vegetation Resources Inventory

Photo Interpretation Procedures

Prepared by
Ministry of Sustainable Resource Management
Terrestrial Information Branch
for the Terrestrial Ecosystem Task Force - Vegetation
Resources Inventory Committee

March 29, 2002

Version 2.4

© The Province of British Columbia
Published by the
Resources Inventory Committee

National Library of Canada Cataloguing in Publication Data

Main entry under title:

Vegetation resources inventory [electronic resource] : photo interpretation procedures – Version 2.4

Previous version published by Ministry of Forests, Resources Inventory Branch.

Available on the Internet.

Issued also in printed format on demand.

Includes bibliographical references: p.

ISBN 0-7726-4708-9

1. Aerial photography in botany - British Columbia - Handbooks, manuals, etc. 2. Aerial photography in forestry - British Columbia - Handbooks, manuals, etc.

3. Photographic interpretation - Handbooks, manuals, etc.

I. British Columbia. Ministry of Sustainable Resource Management. Terrestrial Information Branch. II. Resources Inventory Committee (Canada). Terrestrial Ecosystems Task Force. III. Resources Inventory Committee (Canada). Vegetation Inventory Working Group.

QK203.B7V433 2002 333.95'311'09711 C2002-960026-X

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http://www.publications.gov.bc.ca

Digital Copies are available on the Internet at:

http://www.for.gov.bc.ca/ric

105-06277/

Acknowledgments

Funding of the Resources Inventory Committee work, including the preparation of this document, is provided by the Corporate Resource Inventory Initiative (CRII) and by Forest Renewal BC (FRBC). Preliminary work of the Resources Inventory Committee was funded by the Canada-British Columbia Partnership Agreement of Forest Resource Development FRDA II.

The Resources Inventory Committee consists of representatives from various ministries and agencies of the Canadian and the British Columbia governments as well as from First Nations peoples. RIC objectives are to develop a common set of standards and procedures for the provincial resources inventories, as recommended by the Forest Resources Commission in its report "The Future of our Forests".

For further information about the Resources Inventory Committee and its various Task Forces, please access the Resources Inventory Committee Website at:
http://www.for.gov.bc.ca/ric.

Terrestrial Ecosystems Task Force

The Vegetation Inventory Working Group was formed in 1993 and issued their final report in March 1995 on a "Proposed New Inventory" for British Columbia. The Ministry of Forests, Resources Inventory Branch, in cooperation with the Ministry of Environment and other Ministry of Forests branches and consultants, developed the suite of Vegetation Resources Inventory Procedures based on the recommendations in that report. Many individuals were involved in writing the original version of the various Vegetation Resources Inventory Procedures documents.

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Introduction

Background

The Forest Resources Commission recommended a review of the provincial resource inventory process in its report *The Future of our Forests*. The Resources Inventory Committee (RIC) was established with the objective of achieving common standards and procedures and it, in turn, established several task forces. One of these task forces, the Terrestrial Ecosystems Task Force, set up the Vegetation Inventory Working Group and charged the members with:

> "making recommendations pertaining to the vegetation inventory...[and]... designing and recommending standards and procedures for an accurate, flexible...inventory process."

The Vegetation Inventory Working Group recommended a photo-based, two-phased vegetation inventory program:

- Photo Interpretation
- Ground Sampling

Two tasks were identified to ensure that the desired outcomes were achieved:

1. Design a vegetation-based land classification scheme.
2. Identify vegetation inventory attributes to describe the polygons identified through the land classification scheme.

The Ministry of Forests, assisted by the Ministry of Environment, Lands and Parks, is implementing these recommendations in the Vegetation Resources Inventory.

Vegetation Resources Inventory Process

The Vegetation Resources Inventory is carried out in two phases. The Photo Interpretation phase involves estimating vegetation polygon characteristics from aerial photographs. The Ground Sampling phase provides the information necessary to determine how much of a given attribute is within the inventory area. Ground samples alone cannot be collected in sufficient numbers to provide the specific locations of the land cover characteristics being inventoried.

The relationship between photo estimates and ground samples is used to adjust the photo interpreted estimates and to provide an overall correct answer. The polygon location, with its adjusted characteristics, provides the location within the inventory area.

Principles of the Photo Interpretation Process

- The Vegetation Resources Inventory will cover the entire land base of British Columbia, irrespective of ownership or vegetation values.
- The vegetated land base will be delineated into polygons based on similar vegetation characteristics visible on mid-scale aerial photography (1:15 000).
- Areas of non-vegetated lands will be delineated into similar polygons, and basic attributes will be assigned at the level achievable by photo interpreters with minimal additional training. Such polygons may be further described by experts in a separate process if desired.
- The inventory design does not allow polygon boundaries to be changed by the sampling process.
- The estimate for a polygon will describe land cover types according to the British Columbia Land Cover Classification Scheme.
- The estimation of polygon attributes may indicate that several cover types exist within a polygon boundary. Several land cover types may be described as additional information for resource users.
- All continuous variables will be estimated to the finest level of resolution practical; class-based summaries can be compiled as desired from the detailed data.
- Ancillary data will be used, as available, to provide accurate and consistent estimates of polygon attributes.
- The photo interpretation process strives towards consistency of estimates:
  - by one classifier;
  - between classifiers; and,
  - over time.

> **Note**: A primary goal of the inventory is to produce accurate polygon estimates as accurate estimates are automatically consistent. However, inaccurate estimates are also useful if they are consistently "high" or "low" (if, for example, all height estimates are overestimated by three metres) as these estimates can be adjusted following the ground sampling phase. Inconsistent estimates are undesirable as they may increase the sampling intensity required and lead to greater errors after adjustment.

- All attributes estimated as continuous variables may be adjusted by the sampling process.
- Categorical (non-continuous) attributes will be assigned. As a minimum, these will be reported as to the proportion of times the estimate was determined to be correct by the sampling process. These attributes may also be adjusted.

How to Use this Procedures Document

This document deals with the Photo Interpretation component of the Vegetation Resources Inventory. It describes procedures required to delineate polygons, using the B.C. Land Cover Classification Scheme, and to estimate vegetation inventory attributes within polygons.

A brief background is provided to explain the rationale behind the procedures. The remainder of this procedures document follows the process that is required when delineating polygons and estimating attributes. Section 1 explains the B.C. Land Cover Classification Scheme.

Section 2 describes the procedures required to delineate polygons. Section 3 explains the identification of polygons and the estimation of general and ecological attributes. Sections 4 and 5 describe estimating land cover and site indices and Sections 6, 7, 8, and 9 explain estimation of the attributes related to vegetated portions of polygons. Section 10 describes procedures required to classify the non-vegetated portions of polygons.

Section 11: *Derived Polygon Attributes* identifies and explains the attributes that are derived after the Photo Interpretation and Ground Sampling are complete. Although derived attributes are not the responsibility of the photo interpreter, an understanding of the attributes that will be derived should improve the consistency and quality of estimation overall.

Each of these main sections contains a definition, statement of purpose, and detailed procedures. Where applicable, examples and tips are provided.

A glossary of terms and a detailed index are included to ensure the usability of this document as a reference tool.

Section 1:
Land Cover Classification Scheme[1]

Introduction

The Vegetation Inventory Working Group, a component of the Resources Inventory Committee (RIC), was given the task of creating a land cover classification scheme to meet the needs of British Columbia's resource managers today and in the future. Present inventory systems were found to be inadequate when used to assess integrated resource management options. It was from this perspective, along with growing world wide demand for an accurate assessment of land cover, that this classification was created.

The B.C. Land Cover Classification Scheme was designed to meet present provincial and national needs, and to be capable of providing data for global vegetation accounting. Numerous classifications were considered in the development of the scheme.

The B.C. Land Cover Classification Scheme is based on current cover. Cover can be Vegetated, Non-Vegetated or Unreported. Vegetated cover is either Treed or Non-Treed; Non-Vegetated cover is either Land or Water. In most cases, uniform areas (polygons) are delineated on mid-scale aerial photographs (1:10,000 to 1:20,000). Vegetation types and non-vegetated cover categories can exist as components within larger polygons. Unreported areas may be Vegetated or Non-Vegetated, but their attributes are either unknown (as in the case of parks) or they are outside of the area being reported (as in the case of Tree Farm Licences or Tree Farms).

The purpose of the B.C. Land Cover Classification Scheme is twofold. First, the land classification can be derived for each polygon (or portion thereof), based on the photo interpreter's attribute estimates. The land classification of each polygon is summarized as a seven-letter code (see Levels 1 to 5 following) to facilitate broad land classification reporting, and also to provide a link for comparing land classification accuracy with Ground Sampling data. Second, the B.C. Land Cover Classification Scheme provides the criteria for distinguishing cover types within the polygon. These criteria are critical for assessing specific tree, shrub, herbaceous, bryoid, and non-vegetated communities within polygon boundaries (referred to as land cover components).

The land classification (seven-letter) code for the polygon is not directly assigned by the photo interpreter, it is derived after the photo-interpreted data has been delivered. It is important that photo interpreters be familiar with the derivation process to improve the consistency of photo-interpreted data. Photo interpreters will also apply the classification

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[1] **Note**: Section 1 is adapted from the Vegetation Resources Inventory *B.C. Land Cover Classification Scheme* Document, March, 1999. Contact the Resources Inventory Committee for a copy of this document.

criteria to the description of individual communities (land cover components) within the polygon. Figure 1-1 and Figure 1-2 illustrate the structure of the land classification scheme for Vegetated and Non-Vegetated polygons.

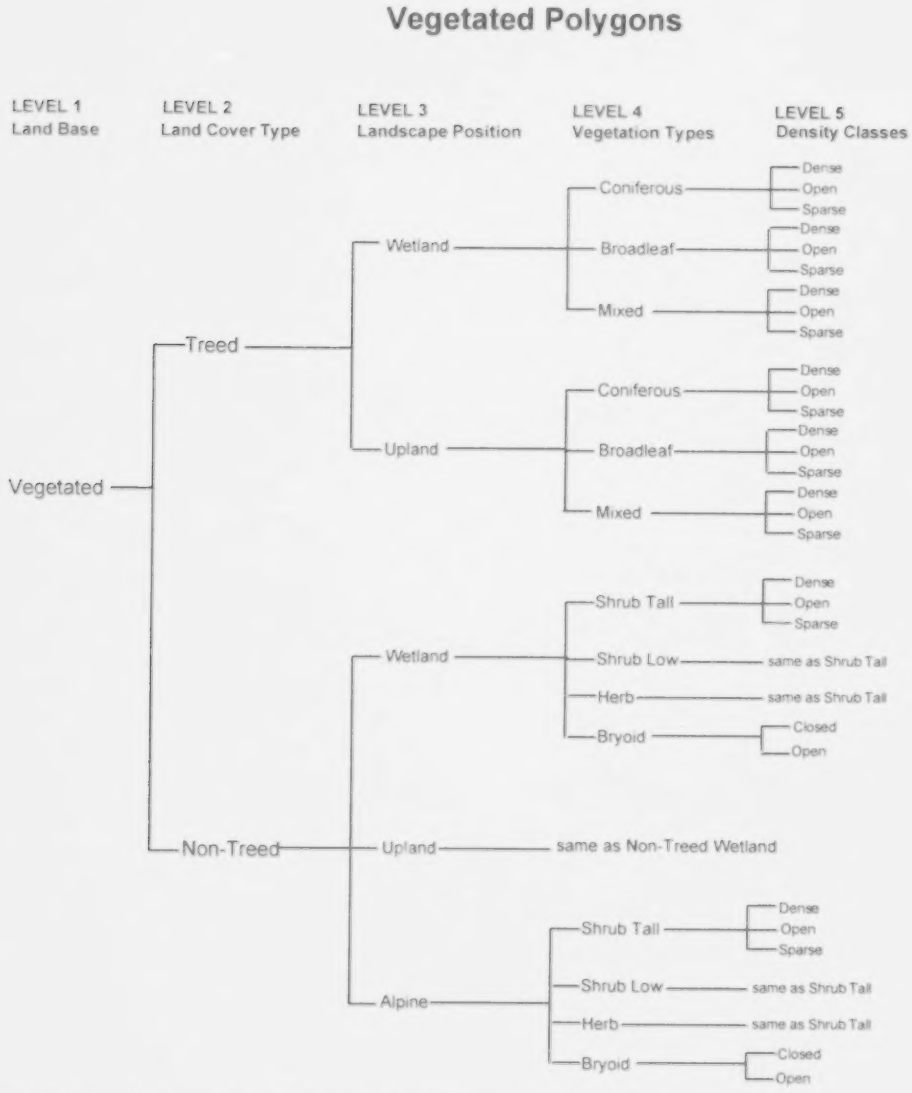


Figure 1.1 – Structure of the B.C. Land Cover Classification Scheme- Vegetated polygons

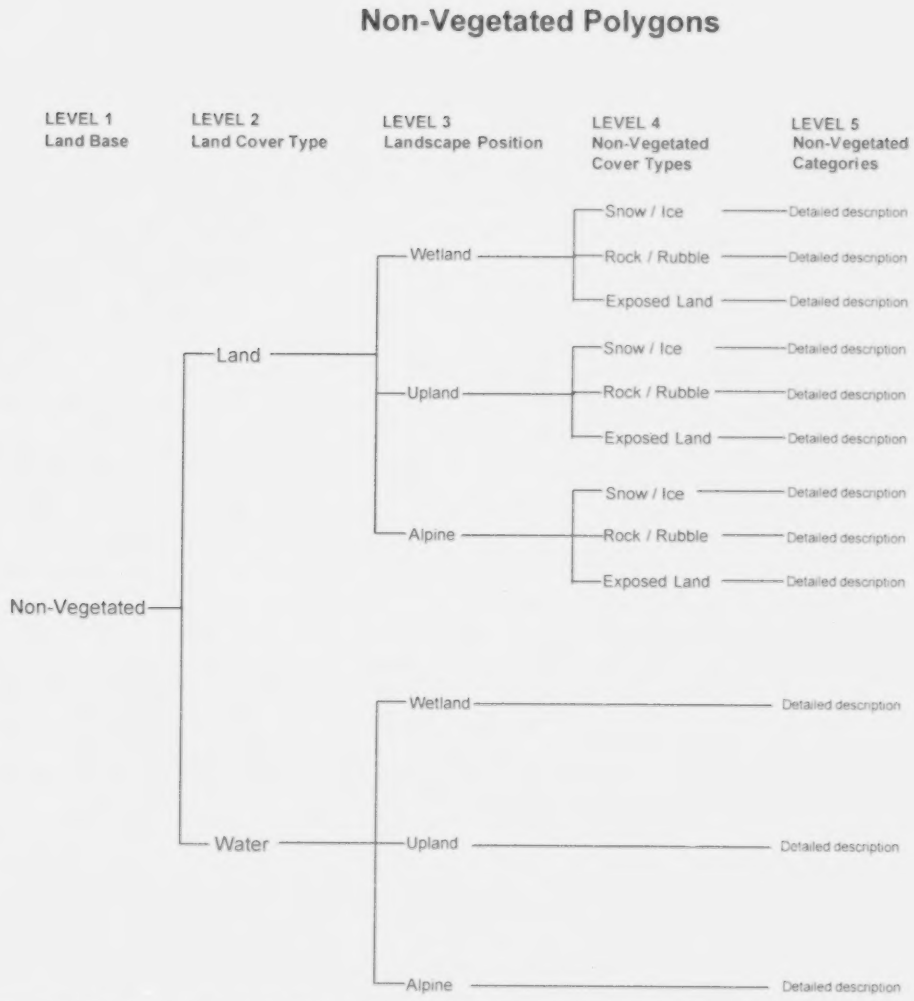


Figure 1.2 – Structure of the B.C. Land Cover Classification Scheme - Non-Vegetated polygons.

The remainder of this section explains the land classification scheme in detail. For a discussion of the derivation of land classification codes based on photo-interpreted estimates, see Section 11 *Derived Polygon Attributes*.

Level 1 Land Base

Definition

The first level of the B.C. Land Cover Classification Scheme classifies the presence or absence of vegetation within the boundaries of the polygon. Presence or absence is recognized by the vertical projection of vegetation upon the land base within the polygon.

Purpose

Assessing the presence or absence of vegetation within the polygon provides the first level of classification of the B.C. Land Cover Classification Scheme and the first level of reporting ability.

Procedure

V = **Vegetated**
A polygon is considered Vegetated when the total cover of trees, shrubs, herbs, and bryoids (other than crustose lichens) covers at least 5% of the total surface area of the polygon.

N = **Non-Vegetated**
A polygon is considered Non-Vegetated when the total cover of trees, shrubs, herbs, and bryoids (other than crustose lichens) covers less than 5% of the total surface area of the polygon. Bodies of water are to be classified as Non-Vegetated.

U = **Unreported**
A polygon is classified as Unreported if it is within the mapsheet being reported on, but is outside the inventory unit of interest. The Unreported designation is restricted to areas where inventory information is not currently available. Examples include National Parks, Provincial Parks (where information is not available), Tree Farm Licences and Tree Farms that are not in the existing vegetation cover databases, and areas outside of the Province of British Columbia.

Note: Bodies of water may have vegetation on or under their surface; they are the responsibility of others to evaluate.

Level 2 Land Cover Type

Definition

The second level of the B.C. Land Cover Classification Scheme classifies the polygon as to the land cover type: treed or non-treed for vegetated polygons; land or water for non-vegetated polygons.

Purpose

Land cover type provides the second level of delineation within the B.C. Land Cover Classification Scheme and provides the second level of reporting ability.

Procedure for Vegetated Polygons

An interpretation is made of the coverage of tree crowns as measured by their vertical projection upon the land base, estimated to the nearest percentage crown closure.

T = **Treed**
A polygon is considered Treed if at least 10% of the polygon area, by crown cover, consists of tree species of any size.

N = **Non-treed**
A polygon is considered Non-Treed if less than 10% of the polygon area, by crown cover, consists of tree species of any size.

Note: The classification scheme applies to the entire land base and equal care should be given to treed and non-treed areas. Non-treed sites are an important part of the landscape as they often contain many diverse and unique species and provide valuable habitat. Without a better appreciation for the types of non-treed sites and their distribution it will be more difficult to assemble new information. Management interpretations and decisions at the large landscape level will be enhanced with the addition of information on non-treed ecosystems.

Procedure for Non-Vegetated Polygons

The polygon is interpreted as to the percentage area occupied by land or water. The cover type occupying greater than 50% of the polygon area is the cover type to be assigned.

L = **Land**
The portion of the landscape not covered by water (as defined below), based on the percentage area coverage.

W = **Water**
A naturally occurring, static body of water, two or more metres deep in some portion, or a watercourse formed when water flows between continuous, definable banks. These flows may be intermittent or perennial; but do not include ephemeral flows where a channel with no definable banks is present. Islands within streams that have definable banks are not part of the stream; gravel bars are part of the stream. Interpretation is based on the percentage area coverage.

Level 3 Landscape Position for Vegetated and Non-Vegetated Polygons

Definition

The third level of the B.C. Land Cover Classification Scheme is the location of the polygon relative to elevation and drainage, and is described as either alpine, wetland, or upland. In rare cases, the polygon may be alpine wetland.

Purpose

The landscape position provides the framework for delineation of ecosystems and habitat and the third level of reporting ability.

Procedure

The polygon is interpreted to see if it has one or more landscape positions. The polygon classification is determined by the landscape position with the majority coverage by area.

W = Wetland
Land having the water table near, at, or above the soil surface, or which is saturated for a long enough period to promote wetland or aquatic processes as indicated by poorly drained soils, specialized vegetation, and various kinds of biological activity which are adapted to the wet environment.

In the Canadian wetland classification, wetland classes include bogs, fens, marshes, swamps, hot springs, hot pools, and shallow water. In British Columbia, Wetlands include forested or non-forested subhydric (SMR 7) sites, in addition to non-forested hydric (SMR 8) ecosystems (see the B.C. Land Cover Classification document for a detailed description).

U = Upland
A broad class that includes all non-wetland ecosystems below Alpine that range from very xeric, moss- and lichen-covered rock outcrops to highly productive forest ecosystems on hygric (SMR 6) soils.

A = Alpine
Treeless by definition (for practical purposes, 1% tree cover or less can be included within the alpine area) with vegetation dominated by shrubs, herbs, graminoids, bryoids, and lichens. Much of the Alpine is non-vegetated, covered primarily by rock, ice, and snow.

The boundary between Alpine and Upland is drawn using the upper elevation of the discontinuous treed area. The Alpine area will not typically include parkland and krummholz forest types. Generalization of the boundary at a consistent elevation (varying with aspect) is necessary as cliffs, rock outcrops, and avalanche chutes often dissect the Alpine/Upland transition. Alpine is a classification level of Non-Treed areas above the tree line only.

Note: **Alpine** is the land area above the maximum elevation for tree species.

Parkland is a landscape characterized by strong clumping of trees due to environmental factors (from *Ecosystems of British Columbia, MoF, 1991*).

Krummholz is the scrubby, stunted growth form of trees, often forming a characteristic zone at the limit of tree growth at high elevations (from *Forest Ecology Terms in Canada, Canadian Forest Service, 1994*).

Level 4 Vegetation Types and Non-Vegetated Cover Types

Definition

The fourth level of the B.C. Land Cover Classification Scheme classifies the vegetation types and Non-Vegetated cover types (as described by the presence of distinct types upon the land base within the polygon).

Purpose

Vegetation types and Non-Vegetated cover types provide the fourth level of delineation within the B.C. Land Cover Classification Scheme and the fourth level of reporting ability.

Procedure for Vegetated Polygons

Vegetated polygons delineated and described in levels 1 to 3 in the land classification scheme are further classified by the vegetation types as listed below. An interpretation is made of the coverage of vegetation crown closure as measured by their vertical projection upon the land base, estimated to the nearest percentage crown closure.

Treed Units

Treed units are split into three groups: Coniferous, Broadleaf, and Mixed.

TC = **Treed - Coniferous**
Defined as those trees found in B.C. within the order Coniferae. These trees are commonly referred to as conifer or softwoods. The polygon is classified as Coniferous when the total basal area (expressed as percentage species composition), of coniferous trees is 75% or more of the total polygon tree basal area, and trees cover 10% or more of the total polygon area, by crown cover.

TB = **Treed - Broadleaf**
Defined as those trees classified botanically as Angiospermae in the subclass Dicotyledoneae. These species are commonly referred to as deciduous or hardwoods. The polygon is classified as Broadleaf when the total basal area (expressed as percentage species composition) of broadleaf trees is 75% or more of the total polygon tree basal area, and trees cover a minimum of 10% of the total polygon area, by crown cover.

TM = **Treed - Mixed**
The polygon is classified as Mixed when neither coniferous nor broadleaf trees account for 75% or more of the total polygon tree basal area, and trees cover a minimum of 10% of the total polygon area, by crown cover.

Non-Treed Units

Non-Treed units are broken into Shrubs, Herbs, and Bryoids.

Shrubs are defined as multi-stemmed woody perennial plants, both evergreen and deciduous. A reporting break is made between Tall (greater than or equal to two metres in height) and Low (less than to two metres in height) for wildlife management interpretation purposes.

Other breaks may be reported by the user as height data are estimated and stored as a continuous variable.

For a polygon to be classified as Non-Treed Shrub it must have more than 5% total vegetation cover, have less than 10% crown cover of trees, and have a minimum of 20% ground cover of shrubs, or shrubs must constitute more than $^1/_3$ of the total vegetation cover.

ST = Shrub Tall
A Shrub polygon with average shrub height greater than or equal to two metres.

SL = Shrub Low
A Shrub polygon with average shrub height less than two metres.

Herbs are defined, for this system, as vascular plants without a woody stem, including ferns, fern allies, some dwarf woody plants, grasses, and grass-like plants. The Herb class has two further subdivisions based on the proportion of graminoids and forbs present.

Graminoids are defined as herbaceous plants with long, narrow leaves characterized by linear venation; including grasses, sedges, rushes, and other related species.

Forbs are defined as herbaceous plants other than graminoids.

For a polygon to be classed as Non-Treed Herb it must have more than 5% total vegetation cover, have less than 10% crown cover of trees, and have 20% or more ground cover of herbs, or herbs must constitute more than $^1/_3$ of the total vegetation cover and the polygon must have less than 20% shrub cover.

HE = Herb
A Herb polygon with no distinction between forbs and graminoids.

HF = Herb - Forbs
A Herb polygon with forbs greater than 50% of the herb cover.

HG = Herb - Graminoids
A Herb polygon with graminoids greater than 50% of the herb cover.

Bryoids are defined as bryophytes (mosses, liverworts, and hornworts) and lichens (foliose or fruticose; not crustose).

For a polygon to be classed as Non-Treed Bryoid it must have more than 5% total vegetation cover, have less than 10% crown cover of trees, and have greater than 50% of the vegetation cover in bryoids, and herb and shrub cover must each be less than 20% crown cover.

BY = Bryoid
A Bryoid polygon with no distinction between mosses and lichens.

BM = Bryoid - Moss
A Bryoid polygon with mosses, liverworts, and hornworts greater than 50% of the bryoid cover.

BL = Bryoid - Lichens
A Bryoid polygon with lichens (foliose or fruticose; not crustose) greater than 50% of the bryoid cover.

Procedures for Non-Vegetated Polygons

Non-Vegetated polygons, delineated and described in levels 1 to 3 of the land classification scheme, are further classified by the Non-Vegetated cover types listed below. An estimation is made of the class that has the greatest percentage coverage by area.

Non-vegetated polygons (within the land cover type) are separated into three groups: Snow/Ice; Rock/Rubble; and Exposed Land.

SI = Snow / Ice
Defined as either glacier, which is considered a mass of perennial snow and ice with definite lateral limits, typically flowing in a particular direction; or other ice and snow cover that is not part of a glacier.

RO = Rock / Rubble
Defined as bedrock or fragmented rock broken away from bedrock surfaces and moved into its present position by gravity or ice. Extensive deposits are found in and adjacent to alpine areas and are associated with steep rock walls and exposed ridges; canyons and cliff areas also contain these deposits.

EL = Exposed Land
Contains all other forms of exposed land identified by a range of subclasses.

Note: The Water cover type (level 2) does not have any classes in this level of the land classification scheme.

Level 5 Vegetated Density Classes and Non-Vegetated Categories

Definition

The fifth level of the B.C. Land Cover Classification Scheme classifies the vegetation density classes and Non-Vegetated categories.

Purpose

Vegetated density classes and Non-Vegetated categories provide the fifth level of delineation within the B.C. Land Cover Classification Scheme and the fifth level of reporting ability.

Procedure for Vegetated Polygons

The Vegetated polygons delineated and described in levels 1 to 4 in the land classification scheme are further classified into density classes as listed below. Note that these are reporting breaks only and interpreters estimate density as a continuous variable.

The density classes for Treed, Shrub and Herb cover are as follows:

DE = **Dense**
Tree, shrub, or herb cover is between 61% and 100% for the polygon.

OP = **Open**
Tree, shrub, or herb cover is between 26% and 60% for the polygon.

SP = **Sparse**
Cover is between 10% and 25% for treed polygons, or cover is between 20% and 25% for shrub or herb polygons.

The density classes for Bryoids is as follows:

CL = **Closed**
Cover of bryoids is greater than 50% of the polygon.

OP = **Open**
Cover of bryoids is less than or equal to 50% of the polygon.

Procedure for Non-Vegetated Polygons

Non-Vegetated polygons delineated and described in levels 1 to 3 in the land classification scheme are further classified into categories as listed below.

Snow/Ice has two subclasses:

GL = **Glacier**
A mass of perennial snow and ice with definite lateral limits, typically flowing in a particular direction.

PN = Snow Cover
Snow or ice that is not part of a glacier but is found during summer months on the landscape.

Rock/Rubble has five subclasses:

BR = Bedrock
Unfragmented, consolidated rock, contiguous with the underlying material.

TA = Talus
Rock fragments of any size accumulated on or at the foot of slopes as a result of successive rock falls. This is a type of colluvium.

BI = Blockfield
Blocks of rock derived from the underlying bedrock by weathering and / or frost heaving. These have not undergone any significant down slope movement as they occur on level or gently sloping areas.

MZ = Rubbly Mine Spoils
Discarded overburden or waste rock, moved to extract ore during mining.

LB = Lava Bed
An area where molten rock has flowed from a volcano or fissure and cooled and solidified to form rock.

Exposed Land has eighteen subclasses:

RS = River Sediments
Silt, gravel, and sand bars associated with former river channels and present river edges.

ES = Exposed Soil
Any exposed soil not covered by the other categories, such as areas of recent disturbance that include mud slides, debris torrents, avalanches, or disturbances such as pipeline rights-of-way or cultivated fields where vegetation cover is less than 5%.

LS = Pond or Lake Sediments
Exposed sediments related to dried lakes or ponds.

RM = Reservoir Margin
Land exposed by a drained or fluctuating reservoir. It is found above "normal" water levels and may consist of a range of substrates including gravel, cobbles, fine sediments, or bedrock.

BE = Beach
An area with sorted sediments reworked in recent time by wave action, which may be formed at the edge of fresh or salt water bodies.

LL = Landing
A compacted area adjacent to a road used for sorting and loading logs.

BU = Burned Area
Land showing evidence of recent burning, either natural or prescribed. Vegetation of less than 5% crown cover is present at the time of polygon description.

RZ = Road Surface
An area cleared and compacted for transporting goods and services by vehicles. Older roads that are used infrequently or not at all may cease to be classed as Non-Vegetated.

MU = Mudflat
Flat plane-like areas associated with lakes, ponds, rivers, or streams — dominated by fine-textured sediments. They can be associated with freshwater or estuarine sources.

CB = Cutbank
Part of a road corridor created upslope of the road surface, created by excavation into the hillside.

MN = Moraine
An area of debris transported and deposited by a glacier.

GP = Gravel Pit
An area exposed through the removal of sand and gravel.

TZ = Tailings
An area containing the solid waste material produced in the mining and milling of ore.

RN = Railway Surface
A roadbed with fixed rails, which may contain single or multiple rail lines.

UR = Urban
Buildings and associated developments such as roads and parking areas which form an almost continuous covering of the landscape.

AP = Airport
A permanent, paved or gravel area, and associated buildings and parking, used by airplanes.

MI = Open Pit Mine
An exposed area used to extract ore during a mining operation. This may contain associated buildings and any tailing produced by the mining and milling process.

OT = Other
A Non-Vegetated polygon where none of the above categories can be reliably chosen.

Water Cover (Level 2) has 4 subclasses:

LA = **Lake**
A naturally occurring static body of water more than two metres deep in some portion. The boundary for the lake is the natural high water mark.

RE = **Reservoir**
An artificial basin affected by impoundment behind a man made structure such as a dam, berm, dyke, or wall.

RI = **River/Stream**
A water course formed when water flows between continuous, definable banks. Flow may be intermittent or perennial but does not include ephemeral flow where a channel with no definable banks is present. Gravel bars are part of a stream, while islands within a stream that have definable banks are not.

OC = **Ocean**
A naturally occurring body of water containing salt or generally considered to be salty.

Section 2:
Polygon Delineation

Introduction

Polygon delineation is based on the B.C. Land Cover Classification Scheme. This land classification scheme includes both vegetated and non-vegetated cover classes over the entire provincial landscape. Polygons identified by the land classification scheme are further divided into similar vegetated or non-vegetated polygons. Detailed polygon attributes are assigned to each polygon, providing an estimated base from which Ground Sampling locations are selected.

Definition

Polygon delineation is the process used to divide the landscape into uniform polygons according to defined criteria. Polygon delineation is based on observable differences in vegetated or non-vegetated covers using mid-scale aerial photography.

Purpose

Delineating polygons provides boundaries for similar or "like" vegetated or non-vegetated land covers. Accurate delineation provides logical units for the estimation of attributes.

Procedure

The photo interpreter normally proceeds from the general to the specific during the delineation process. The order in which delineation is accomplished will vary from individual to individual so the following steps are provided as an example that may be modified as required. The photo interpreter will use the land classification scheme to guide the process of delineating polygons. The primary types of attributes that drive the delineation process are:

- land classification scheme criteria;
- vegetation attributes;
- mensurational attributes; and,
- ecological attributes (where appropriate).

The objective of delineation is to identify distinctly recognizable vegetated or non-vegetated polygons which are uniform or similar. In many cases, the polygon will be a complex of vegetated and/or non-vegetated areas. In these cases, it may still be necessary to delineate the cover as one polygon due to the limitations of minimum polygon size.

Example:

These steps may be taken to delineate a treed landscape on a mountain slope.

1. Delineate the alpine from the upland.

2. Delineate areas of wetland.
3. Delineate vegetated from non-vegetated.
   (A Vegetated polygon must have vegetation crown cover of 5% or greater.)

If the polygon is Vegetated, then:

4. Delineate Treed versus Non-Treed.
   (A Treed polygon must have 10% or greater tree crown cover.)

   Treed areas:

   - Delineate Coniferous versus Broadleaf composition based on crown closure.
   - Further delineation will be done as appropriate for a combination of attributes such as species, age, height, crown closure, or a combination of others.

   Non-Treed areas:

   - Delineate by Shrub versus Herb versus Bryoid.
   - Further delineation will be done as appropriate for a combination of attributes such as shrub height, herb cover type, vegetation density, and others.

If polygon is Non-Vegetated, then:

1. Delineate by category of Non-Vegetated cover type.

Guidelines

The delineation process is very much an interpretive art. The delineation of polygons can be achieved with various differentiations that may all be appropriate. In order to achieve some consistency, by each interpreter and between interpreters, the following guidelines are suggested. These guidelines may vary depending on each user's needs and the complexity of the project area. In many cases, information will be available from silviculture on various stand conditions.

Table 2.1 – Delineation guidelines for Treed polygons

Polygon Attribute Classification	Species Composition	Age	Height	Crown Closure
Silviculture Opening	Silviculture Records	Silviculture Records	Silviculture Records	Silviculture Records
Age ≤ 50 yrs or Height ≤ 20 m	When to delineate polygons: 1. if there is ≥20% difference in leading species composition; or 2. if there is a switch in the leading species; or 3. if there is a different 2nd species present; or 4. if the species composition changes from a mixed species stand to a pure stand.	Difference between adjacent stands should be at least 10 yrs.	Difference between adjacent stands should be at least 3 m.	Difference between adjacent stands should be at least 20%.
50< Age ≤ 140 or 20m< Ht ≤30m		Difference between adjacent stands should be at least 20 yrs.	Difference between adjacent stands should be at least 3-5 m.	Difference between adjacent stands should be at least 20%.
Age > 140 yrs or Height > 30 m		Difference between adjacent stands should be at least 50 yrs.	Difference between adjacent stands should be at least 5-10 m.	Difference between adjacent stands should be at least 20%.

Adapted from Forest Inventory Manual, Forest Classification / Sampling and Environmentally Sensitive Areas, Vol.2, MoF, 1992.

For stands that have not achieved free growing status, and where silvicultural records are not available, the interpreter will delineate polygons based on observable, recognizable differences in vegetation, using the guidelines listed in Table 2-1.

Minimum polygon size

In many instances, the identifiable features on a photograph could result in a large number of polygons, a level of detail that is unnecessary for a provincial inventory and unmanageable for local users. The minimum polygon size should be set by the contract supervisor as local user needs are identified. The minimum sizes suggested to meet the needs of the provincial inventory are:

1. Areas with distinct boundaries - minimum 2 hectares.

   Where polygon boundaries are readily recognizable and distinct on the air photo, a minimum polygon size of 2 hectares is appropriate.

   For example: Treed versus Shrub complex; Herb complex versus Rock Talus area; 10 m trees versus 32 m trees.

2. Areas with indistinct boundaries minimum - 5 hectares.

   Where polygon boundaries are not readily recognizable on the air photo, a minimum polygon size of 5 hectares is appropriate.

   For example: a Treed area with a gradual height difference graduating from 30 m to 35 m; a repetitious complex area with ridge and swale vegetation complexes; high-elevation Treed areas with dispersed patches of rock outcrop.

Delineation of distinct features

In some instances, the polygon size minimums may not be appropriate. In instances where unique Vegetated or Non-Vegetated complexes are noted, these may be delineated. This may locate high-value resources for the users or significant features for field navigation by map users. See the following example:

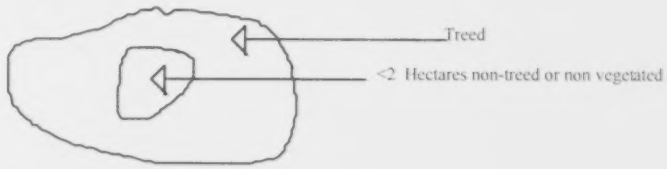


Figure 2.1 – Delineation of distinct features

Up to three ecologically distinct components can be described within each polygon, although most polygons will contain only a single land cover type. A compromise is made between detailed delineation, with relatively simple attributes, and broader delineation with more complex descriptions. A repeating pattern of two distinct land cover types is a good candidate for broader typing.

Tips:

- Avoid detailed delineation in Non-Vegetated land.
- Avoid complicated, irregular type lines in landscapes with indistinct polygon boundaries. In areas with distinct features, these irregular polygon boundaries may be valuable aids in navigation, etc.
- The following natural boundaries are polygons on the base map and therefore do not require further delineation:
  - double line rivers;
  - lake shores; and,
  - saltwater shores.

- Strive for consistency in delineation by each photo interpreter and between interpreters. Some useful aids may be to:
  - review daily project sample photos;
  - frequently discuss estimates, issues, and problems with other interpreters; and,
  - review the previous day's photos before beginning current day's activities.

Section 3: General Attributes

Introduction

Delineated polygons are assigned descriptions that are either estimates of polygon characteristics or contain other information relating to the polygon. This section describes general attributes that include information about the polygon and descriptions of ecological characteristics.

Polygons and the accompanying attributes may have applications in areas such as determining the distribution and coverage of ecosystems, landscape patterns, wildlife habitat values, biological diversity, land sensitivities for forestry, forest and ecosystem productivity, silviculture and harvesting options, and land use planning. Government, private companies, and educational institutions will be major users of such information.

Attributes are polygon-based estimates. The polygon is uniquely identified and subsequent qualitative and quantitative measurements are made for all Vegetated and Non-Vegetated covers observed in the polygon. Cover types within the polygon, which are too small to delineate, may be described as land cover components.

This section describes the process of identifying the polygon and estimating general attributes and includes:

- polygon number
- surface expression
- site position meso
- soil nutrient regime
- data source
- modifying processes
- alpine designation

3.1 Polygon Number

Definition

The polygon number is a unique number assigned to each Vegetated or Non-Vegetated polygon after it is delineated. The intent is to assign a unique polygon number to each polygon in British Columbia. As the polygon boundary or attributes change, a "new" unique number will be assigned and the "old" unique number will be archived.

Purpose

The polygon number provides the link between the graphic and descriptive files.

Procedure

Assign unique polygon numbers sequentially and systematically, based on a square-edged map, throughout the project area (e.g., BCGS map sheet).

- Administrative boundaries do not constitute polygon boundaries.
- Forest Inventory Zones (FIZ) that separate coastal from interior forest zones do not constitute polygon boundaries.

Figure 3-1 indicates one of the methods of polygon numbering for a BCGS map sheet.

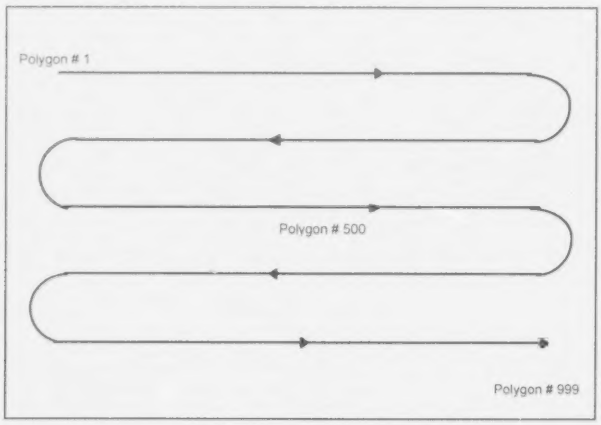


Figure 3.1 – One method of polygon numbering layout.

3.2 Data Source

Definition

Data source refers to the primary source of information used for the attribute or attributes being described.

Purpose

The data source will provide an indication of the reliability of attribute descriptions and may be used in the pre-inventory analysis (PIA) process. The data source may also be used to assess training issues, such as the reliability of estimates with various data sources.

Procedures

Data sources provide calibration points to aid in the determination of polygon attributes. The photo interpreter may, or may not, have data sources available within a polygon to aid in the interpretation. The interpreter will use available data sources (see Table 3-1) and interpretive skills to make the appropriate estimation for the polygon.

The interpreter will:

- Assign one data source code to each of the following attributes or set of attributes:
  - ecological information (primarily SMR and SNR)
  - species composition
  - age of the leading species
  - height of the leading species
  - tree basal area
  - tree density
- If two or more data sources occur within the same polygon for a specific attribute or set of attributes, use the attribute descriptions from the most appropriate source that describes the polygon estimate.
- When several data sources are available, reference only the source used in the polygon attribute estimate.
- In multi-layered stands, assign a data source code for each tree layer.

Table 3.1 – Data source codes

Codes	Data Sources	Possible Applications
0	Photo interpretation	
1	Air call (air observation without 70 mm photography)	species composition
2	Air call from low-level, fixed base (70 mm photography)	species comp., height
3	Phase 1 photo sample (pre-1990)	
4	Ground call 1 point	age, height
5	Standard fixed radius sample (pre-1979)	age, height
6	Phase 2 or phase 3 sample (pre-1990)	species, age, height, density, basal area
7	Silviculture surveys - stocking, survival, free growing, pre-stand tending	species composition, density, SMR, SNR
8	Ground observation with measurement	age, height
9	Research plots (e.g. Sx trials, ecological site description)	species, age, height
10	Valuation cruise plot(s)	basal area, species composition, height
11	Silviculture treatment record - a record that summarizes the modified stand structure following an activity or treatment such as planting, juvenile spacing, brushing and weeding, conifer release, seed tree control, sanitation spacing, rehabilitation or commercial thinning	
12	Disturbance - an area recently disturbed by fire, logging, windthrow, or insects that is classified as NSR. Has no source of information other than type and year of disturbance	
13	Managed stand sample	
14	Ground call, 2 or more points	age, height, species composition
16	Vegetation sample	age, height, density, basal area, SMR, SNR
17	Vegetation ground call	age, height, density, basal area, SMR, SNR
18	Vegetation air call	species composition, shrub height, shrub %
19	Natural growth sample	species, age, height
20	Volume and depletion sample	age, height
22	Photogrammetrically captured information that is determined or captured using photogrammetric means. An example of this is the determination of photo-measured heights using softcopy technology or parallax bars.	height

3.3 Surface Expression

Definition

Surface expression refers to the form and patterns of form of the surficial material within the polygon (see p. 26, *Terrain Classification System for British Columbia*, D. Howes and E. Kenk, MOE Manual 10, Dec. 1988).

Purpose

Given the specialized nature of comprehensive terrain classification, and the fact that the ground surface is often blanketed by a canopy of trees, a simple classification attribute was selected. Surface expression is relatively easy to photo interpret, and together with the attributes "modifying processes" and "site position meso" will provide clues to soil parent material and useful site classification data.

Procedure

Assign the appropriate letter code (from Table 3-2) to each polygon. In polygons that have multiple components, record the prevalent surface expression of the polygon on the basis of greatest percent area coverage.

Table 3.2 – Description of surface expression

Codes	Description
C	**Cone** A cone, or segment of a cone, with a relatively smooth slope gradient, greater than 15 degrees (>25%).
D	**Depression** Circular or irregular area of lower elevation (such as a hollow) than the surrounding terrain; depressions are greater than two metres deep. Examples are kettle holes and karst depressions
F	**Fan** A smooth segment of a cone with a slope gradient of up to 15 degrees (25%). Typically applied to fluvial or alluvial fans.
H	**Hummock(s)** Steep sided hillocks and hollows with slopes of 15 to 35 degrees (25 to 70%) predominant on unconsolidated materials, and slopes of 15 to 90 degrees (25% to vertical) predominant on bedrock. Slopes are non-linear (not parallel) but, generally, chaotic or dissected and rounded or irregular in profile. Local relief is greater than one metre. Differentiated from undulating on the basis of slope angle.
M	**Rolling** Elongated hillock(s) with slopes dominantly between 3 and 15 degrees (5 to 25%) with local relief greater than one metre. Slopes are an assemblage of parallel or sub-parallel linear forms with subdued relief and may occur in level or sloped meso slope positions.
N	**None** of these descriptions apply as no apparent surface expression features are present.

Codes	Description
P	**Plain** A level or gently sloping unidirectional surface with gradients of up to three degrees (5%). Local surface irregularities generally have a relief of less than one metre.
R	**Ridge(s)** Elongated or linear, parallel or sub-parallel hillock(s) or ridges with slopes predominantly between 15 and 35 degrees (25 to 70%) on unconsolidated materials and between 15 and 90 degrees (25% to vertical) on bedrock. Local relief is greater than one metre. Differentiated from rolling on the basis of slope angle. Possible locations include drumlinized till plains, eskers and ridged bedrock. These may be created through the erosional effects of water.
T	**Terrace(s)** Step-like topography where each step-like form consists of both a scarp face and a horizontal or gently inclined surface above it. The terrace description is applied to both the scarp and the flat surface.
U	**Undulating** Gently sloping hillock(s) and hollow(s) with slopes of up to 15 degrees (25%). Local relief is greater than one metre. Slopes are non-linear (not parallel), chaotic forms that are rounded or irregular in profile.

3.4 Modifying Processes

Definition

Modifying processes are natural mechanisms of weathering, erosion and deposition that result in the modification of surficial materials and land forms at the earth's surface (see p.39, *Terrain Classification System for British Columbia*, D. Howes and E. Kenk, MOE Manual 10, Dec. 1988). Only active modifying processes are to be assigned.

Purpose

Modifying processes are used for terrain classification. These processes provide information for site classification, soil conditions, and identify potential hazards such as avalanches, slope instability, and flooding.

Procedure

Assign the appropriate code (from Table 3-3) to each polygon. The code is recorded for the prevalent modifying process within the polygon on the basis of percent area coverage. If a modifying process is not observed in the polygon, "N" (None) should be entered in the column for this attribute. A process is considered active if there is evidence of current or recent occurrence or likely future occurrence. This is not defined in quantitative terms (such as every 25 years) as the quantitative assessment of frequency is often very difficult.

Table 3.3 – Description of modifying processes

Codes	Description
A	**Avalanching** Slopes modified by the rapid downslope movement of snow and ice and by the deposition of rock debris, surficial material and vegetation debris transported by snow avalanches. Sites usually contain avalanche chutes and run out zones but may also be affected by ice falling from glaciers.
B	**River channeling** Erosion and channel formation by the flow of water within clearly defined banks.
F	**Mass movements** Down slope movement of cohesive or non-cohesive surficial material and/or bedrock by creeping, sliding, flowing or falling. This includes rock and debris slides, soil slumps and talus slopes.
N	**None** of these descriptions apply; no modifying processes are observed in the polygon.
U	**Flooding** Areas subject to periodic (possibly seasonal) inundation with subsequent deposition of soil particles. Commonly applied to ephemeral lakes.
V	**Gully erosion** Modification of unconsolidated or consolidated surfaces by processes such as running water and snow avalanching that result in the formation of parallel or sub-parallel long, narrow ravines. Singular gullies are not generally included in this class.

3.5 Site Position Meso

Definition

Site position meso is the relative position of the polygon within a catchment area which often falls within one of the major slope segments of site position macro. Site position macro applies to the scale perspective of mountain top to main valley floor, with vertical distance in excess of 300 metres in most mountain regions. The scale of vertical distance for site position meso is usually between 3 m and 300 m. Ideally, site position meso applies to the scale of topography affecting surface water flow. In some simple landscapes, site position meso and macro are the same (see p.31, *Describing Ecosystems in the Field*, H. Luttmerding et al, MOE Manual 11, Dec. 1990).

Purpose

Site position meso is one of the key attributes for site series identification. Identification of soil moisture regime, using environmental properties, is done with reference to categories of site position meso.

Procedure

The various descriptions of meso slope by site position are illustrated in Figure 3-2. A code is recorded for each polygon for the prevalent site position meso of the polygon on the basis of percent area coverage. The alphabetic codes used to identify site position are described in Table 3-4.

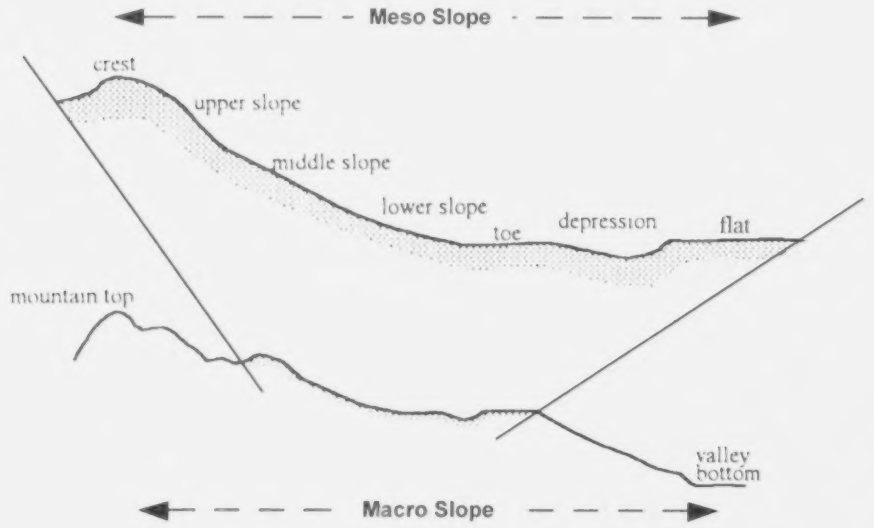


Figure 3.2 – Schematic of site position meso interpretation.

Table 3.4 – Description of site position meso

Codes	Description
C	**Crest** The generally convex uppermost portion of a hill (meso scale). It is usually convex in all directions and generally has no distinct aspect. The term "crest" may also be applied to a ridge.
U	**Upper slope** The generally convex, upper portion of the slope of a hill (meso scale) immediately below the crest. It has a convex surface profile with a specific aspect.
M	**Middle slope** The area of the slope of a hill between the upper and lower slope, where the slope profile is not generally concave or convex. It has a straight or somewhat sigmoid surface profile with a specific aspect.
L	**Lower slope** The area toward the base of the slope of the hill. It generally has a concave surface profile with a specific aspect.
T	**Toe** The area differentiated from the lower slope by an abrupt decrease in slope gradient. It is often characterized by seepage.
D	**Depression** Any area that is concave in all directions. It is generally at the foot of a meso scale hill or in a generally level area.
F	**Flat (Level)** Any level area not immediately adjacent to a meso scale hill (or toe). The surface profile is generally horizontal with no significant aspect.

3.6 Alpine Designation

Definition

Alpine designation pertains to one category of landscape position (the third level of the B.C. Land Cover Classification Scheme). It describes the location of the polygon relative to elevation by assigning a classification: Alpine or Not Alpine. Subsequent information on the relative soil moisture regime (SMR) will identify Wetlands.

Purpose

Alpine designation contributes to the framework for delineation of ecosystems and habitat and the third level of reporting ability.

Procedure

The polygon is interpreted to see if it is above or below the tree line. The boundary between Upland and Alpine is drawn using the upper elevation of the discontinuous treed area. The alpine areas will not typically include parkland and krummholz forest types.

Note: **Alpine** is the land area above the maximum elevation for trees.

Parkland is a landscape characterized by strong clumping of trees due to environmental factors (from *Ecosystems of British Columbia, MoF, 1991*).

Krummholz is the scrubby, stunted growth form of trees, often forming a characteristic zone at the limit of tree growth at high elevations (from *Forest Ecology Terms in Canada, Canadian Forest Service, 1994*).

Generalization of the Alpine boundary at a consistent elevation (varying with aspect) is necessary as cliffs, rock outcrops, and avalanche chutes often dissect the Alpine/Upland transition. Assign the appropriate code to each polygon (see Table 3-5).

Table 3.5 – Description of alpine designation

Codes	Description
A	**Alpine** Alpine is the land area above the maximum elevation for tree species, dominated in vegetated areas by shrubs, herbs, bryoids and lichens. Much of the Alpine is non-vegetated covered primarily by rock, ice and snow. The Alpine is treeless by definition, however, there may be a few rare trees (≤1% crown closure).
N	**Not Alpine** Areas not included in Alpine areas, as defined above.

3.7 Soil Nutrient Regime

Definition

Soil Nutrient Regime (SNR) refers to the relative amount of essential soil nutrients, particularly nitrogen, available to vascular plants over a period of several years.

Purpose

Soil nutrient regime is an interpretive attribute which, together with soil moisture regime, is used to assist in site series identification.

Procedure

Assign one of the SNR alphabetic codes to the polygon. The code is recorded for the dominant SNR of the polygon on the basis of percent area coverage. As outlined on Table 3-6, SNR is potentially a six-point scale from A to F. However, F (saline, excess accumulations of a variety of salts) is uncommon in the larger landscape. Examples of polygons with an F nutrient status include non-forested alkaline marshes around shallow ponds in the dry southern interior, and tidal marshes associated with deltaic river deposits.

Table 3.6 – Soil nutrient regime classes

Codes	SNR classes	Codes	SNR classes
A	Very poor	D	Rich
B	Poor	E	Very rich
C	Medium	F	Ultra rich (saline, excess accumulations of variety of salts).

Keys for identification of SNR are normally designed for use at ground level. SNR identification typically involves a look at the soil for information on humus form, type of A horizon, soil depth, moist colour, texture, coarse fragment content, and type of parent material. In addition, one would look for nutrient indicator plants and their coverage. Table 3-7 draws together attributes that will aid SNR identification, when as many as possible of the attributes are considered.

Tree distribution across nutrient regimes is drawn with a wide brush, as the same species can be limited to narrower SNR bands in different biogeoclimatic subzones. For instance, in the wetter subzones of the Coastal Western Hemlock zone, shore pine or lodgepole pine is essentially restricted to very poor and poor SNRs, whereas in the drier subzones of the Interior Cedar-Hemlock zone, lodgepole pine ranges from very poor to rich SNRs.

In polygons where soil is not available for vascular plants to grow in, the soil nutrient regime field should be left blank. Polygons that have the following dominant strata types should have a blank attribute in the SNR field:

lakes, rivers, reservoirs, salt water, glaciers, road surface (paved, not gravel), buildings and parking and airports (paved, not gravel).

Note that this does not apply to polygons where the above features are not the dominant type. Normal procedures apply to polygons that are vegetated or non-vegetated and they have one of the listed cover types as a non-dominant portion of that polygon.

For water bodies, note that the standard code for the ecology features is:

Surface expression - D (depression)
Modifying processes - N (none)
Site position meso - D (depression)
Alpine designation - will depend on the location in the landscape
Soil nutrient regime - blank

Table 3.7 – A selection of attributes to assist estimation of SNR through air photo interpretation

GENERALIZED SNR	Poor	Medium	Rich
SOIL NUTRIENT REGIME	A very poor B poor	C medium	D rich E very rich
SITE POSITION MESO	upper	middle	lower
MINERAL SOIL MATRIX	coarse	medium	fine
COVER OF ROCK OUTCROPS	high (>50%)	medium (15-50%)	low (<15%)

ROCK TYPE	conglomerate quartzite sandstone	other rock types	dolomite limestone
RELATIVE PRODUCTIVITY	low	medium	high
Proposed SNR Relations For Selected Tree Species In Their Main Climatic Distributional Range:			
Douglas-fir	<----------Fd---------->		
Yellow-cedar	<----------Yc---------->		
Western red cedar	<----------Cw---------->		
Black spruce	<----------Sb---------->		
Shore and lodgepole pine	<----------Pl---------->		
Arbutus	<----------Ra---------->		
Western hemlock	<----------Hw---------->		
Mountain hemlock	<----------Hm---------->		
Trembling aspen	<----------At---------->		
Paper birch	<----------Ep---------->		
Red alder	<----------Dr---------->		
Engelmann spruce	<----------Se---------->		
White spruce	<----------Sw---------->		
Whitebark pine	<----------Pa---------->		
Western larch	<----------Lw---------->		
Alpine larch	<----------La---------->		
Grand fir	<----------Bg---------->		
Amabilis fir	<----------Ba---------->		
Subalpine fir	<----------Bl---------->		
Yellow (ponderosa) pine	<----------Py---------->		
Garry oak	<----------Qg---------->		
Sitka spruce	<----------Ss---------->		
Bigleaf maple	<----------Mb---------->		
Tamarack	<----------Lt---------->		
Balsam poplar	<----------Acb---------->		
Black cottonwood	<----Act---------->		

Identification: These are guidelines only and are not intended to substitute for regular field truth checks and practical knowledge of site classification as presented in the Ministry of Forests "Field Guide for Site Identification and Interpretation ..." for the forest region in question. The tree nutritional relations interpretations have been adapted from Karjina, V.J., K. Klinka and J. Worrall. 1982. Distribution and ecological characteristics of trees and shrubs of British Columbia. UBC Faculty of Forestry. 131 pp. T. Lewis has provided valuable suggestions and ideas for this key.

Section 4:
Land Cover Component Attributes

Introduction

The entire polygon will fall within a single land cover classification within the B.C. Land Cover Classification Scheme (see Section 1). Land cover types within the polygon that contribute to the overall polygon description, but are too small to be delineated using current guidelines, may be described by land cover components. For each land cover component identified within a polygon, a percent area coverage and a soil moisture regime will be recorded. For information on derived land cover class and soil moisture regime at the polygon level, refer to Section 11 *Derived Attributes*.

4.1 Land Cover Components (LCC #1, #2, #3)

Definition

Land cover component identifies a type of land cover under the B.C. Land Cover Classification Scheme, to the most detailed level possible (Level 4 for Vegetated; Levels 4 or 5 for Non-Vegetated).

Purpose

The land cover component identifies a portion of the total polygon area that would be uniquely described if a finer delineation criteria were applied. This information will provide further spatial description of each land cover component for forest management purposes and will also be used in interpretation of wildlife habitat.

Procedure

Enter the appropriate two-letter code (see Tables 4-1 and 4-2) for any polygon component that:

- consists of continuous area(s) that are individually greater than or equal to 10% of the polygon area;
- is distinct at levels 4 or 5 of the B.C. Land Cover Classification Scheme; and,
- would otherwise be delineated and classified at approximately twice the map scale.

Describe up to three land cover components (in decreasing size, by area).

Enter the appropriate code under Land Cover Component #1, Land Cover Component #2 and Land Cover Component #3.

If more than three components exist, the remaining percent cover is recorded under "Other Land Cover Component Percent Coverage."

Table 4.1 -- Land cover component codes - Vegetated

Codes	Description
TB	**Treed Broadleaf** A Treed polygon where 75% or more of the tree basal area, expressed as percentage species composition, consists of broadleaf cover.
TC	**Treed Coniferous** A Treed polygon where 75% or more of the tree basal area, expressed as percentage species composition, consists of coniferous cover.
TM	**Treed Mixed** A Treed polygon where neither coniferous nor broadleaf cover individually constitutes at least 75% of the tree basal area, expressed as percentage species composition.
ST	**Shrub Tall** A Shrub polygon with shrub height of two metres or more.
SL	**Shrub Low** A Shrub polygon with shrub height less than two metres.
HE	**Herb** A Herb polygon with no distinction between forbs and graminoids.
HF	**Herb - Fords** A Herb polygon with forbs greater than 50% of the herb cover.
HG	**Herb - Graminoids** A Herb polygon with graminoids greater than 50% of the herb cover.
BY	**Bryoid** A Bryoid polygon with no distinction between mosses and lichens.
BM	**Bryoid - Moss** (bryophytes) A Bryoid polygon with bryophytes greater than 50% of the bryoid cover.
BL	**Bryoid - Lichens** A Bryoid polygon with lichens greater than 50% of the bryoid cover.

Table 4.2 – Land cover component codes - Non-Vegetated

Codes	Description
SI	**Snow / Ice** Either glacier (which is considered a mass of perennial snow and ice with definite lateral limits, typically flowing in a particular direction) or other ice and snow cover that is not part of a glacier.
GL	**Glacier** A mass of perennial snow and ice with definite lateral limits, typically flowing in a particular direction.
PN	**Snow Cover** Snow or ice that is not part of a glacier, but is found during summer months on the landscape.
RO	**Rock / Rubble** Bedrock or fragmented rock broken away from bedrock surfaces and moved into its present position by gravity or ice. Extensive deposits are found in and adjacent to alpine areas and are associated with steep rock walls and exposed ridges; canyons and cliff areas also contain these deposits.
BR	**Bedrock** Unfragmented, consolidated rock contiguous with underlying material.
TA	**Talus** Rock fragments of any size accumulated on or at the foot of slopes as a result of successive rock falls. This is a type of colluvium.
BI	**Blockfield** Blocks of rock derived from the underlying bedrock by weathering and/or frost heaving. These have not undergone any significant down slope movement as they occur on level or gently sloping areas.
MZ	**Rubbly Mine Spoils** Discarded overburden or waste rock, moved to extract ore during a mining operation.
LB	**Lava Bed** An area where molten rock has flowed from a volcano or fissure and cooled and solidified to form rock.
EL	**Exposed Land** All other forms of Exposed Land identified by a range of subclasses.
RS	**River Sediments** Silt, gravel, and sand bars associated with former river channels and present river edges.
ES	**Exposed Soil** Any exposed soil not covered by other categories, such as areas of recent disturbance that include mud slides, debris torrents, avalanches, or disturbances such as pipeline rights-of-way or cultivated fields where vegetation cover is less than 5%.
LS	**Pond or Lake Sediments** Exposed sediments related to dried-up lakes or ponds.

Codes	Description
RM	**Reservoir Margin** Land exposed by a drained or fluctuating reservoir. It is found above "normal" water levels and may consist of a range of substrates including gravel, cobbles, fine sediments, or bedrock.
BE	**Beach** An area with sorted sediments reworked in recent time by wave action. It may be formed at the edge of fresh or salt water bodies.
LL	**Landing** A compacted area adjacent to a road used for the purpose of sorting and loading logs.
BU	**Burned Area** Land showing evidence of recent burning, either natural or prescribed. Vegetation of less than 5% crown cover is present at the time of polygon description.
RZ	**Road Surface** An area cleared and compacted for transporting goods and services by vehicles. Older roads that are used infrequently or not at all may cease to be classed as Non-Vegetated.
MU	**Mudflat Sediment** Flat plain-like areas associated with lakes, ponds, rivers, or streams - dominated by fine-textured sediments. They can be associated with freshwater or estuarine sources.
CB	**Cutbank** Part of a road corridor created upslope of the road surface by excavation into the hillside.
MN	**Moraine** An area of debris transported and deposited by a glacier.
GP	**Gravel Pit** An area exposed through the removal of sand and gravel.
TZ	**Tailings** An area containing the solid waste material produced in the mining and milling of ore.
RN	**Railway** A roadbed with fixed rails which may contain single or multiple rail lines.
UR	**Urban** Buildings and associated developments such as roads and parking areas which form an almost continuous covering of the landscape.
AP	**Airport** A permanent, paved or gravel area, and associated buildings and parking, used by airplanes.
MI	**Open Pit Mine** An exposed area used to extract ore during a mining operation. This may contain associated buildings and any tailing produced by the mining and milling process.

Codes	Description
OT	**Other** A Non-Vegetated polygon where none of the above categories can be reliably chosen.
	Water Cover
LA	**Lake** A naturally occurring static body of water more than two metres deep in some portion. The boundary for the lake is the natural high water mark.
RE	**Reservoir** An artificial basin affected by impoundment behind a structure such as a dam, berm, dyke, or wall.
RI	**River/Stream** A watercourse formed when water flows between continuous, definable banks. Flow may be intermittent or perennial, but does not include ephemeral flow where a channel with no definable banks is present. Gravel bars are part of a stream, while islands within a stream that have definable banks are not.
OC	**Ocean** A naturally occurring body of water containing salt or generally considered to be salty.

4.2 Land Cover Component Percent (LCC #1, #2, #3)

Definition

Land cover component percent is the estimation of the percentage of the polygon occupied by each land cover component identified by the photo interpreter.

Purpose

Land cover component percent quantifies the extent of each land cover component identified. It provides for reporting to a finer resolution than the polygon unit and can be used to model wildlife habitat capability.

Procedures

Examine the polygon to determine how many land cover components are present. Individual component pieces that make up less than 10% of the polygon area should not be estimated for land cover components. Each land cover component should have a minimum of one contiguous piece that makes up at least 10% of the polygon area. Individual pieces or patches that are individually at least 10% of the polygon may be combined such that the amalgamation of those individual pieces could constitute 20% of the polygon area or greater.

Record land cover component percent to the nearest percent. The total of all land cover component percent values must equal 100%.

Estimate percent cover for Land Cover Component #1, Land Cover Component #2 and Land Cover Component #3. If more than three components exist, the remaining percent cover is recorded under "Other Land Cover Component Percent Coverage." More than one land cover component type may be grouped together in the "Other Land Cover Component Percent Coverage" category to achieve the required total value of 100%.

4.3 Soil Moisture Regime (LCC#1, #2, #3)

Definition

Soil Moisture Regime (SMR) refers to the average amount of soil water annually available for evapotranspiration by vascular plants over several years. The "relative" SMR scale applied here has nine classes. Within a specific climatic regime, such as a biogeoclimatic variant, the soil moisture status is comparatively constant for any of the SMR classes. However, between different climatic regimes the same SMR classes can represent dramatically different soil moisture content.

Purpose

SMR is an interpretative attribute to aid in the estimation of site potential and site series classification.

Procedure

View a substantial portion of the project area to evaluate the range of conditions to be encountered within a given biogeoclimatic subzone variant. Biogeoclimatic maps and ground calibration points will aid in this interpretation. From this observation the average (zonal) soil moisture regime can be visualized. The zonal SMR is normally a value of 4. The interpretation of individual polygons can then be calibrated as to how much drier or wetter the area is in relation to the zonal SMR.

Assign the estimate of the SMR (see Table 4-3) for each land cover component (LCC #1, #2, #3) identified in the polygon.

Table 4.3 – Soil moisture regime classes

Codes	SMR classes	Codes	SMR classes
0	very xeric	5	subhygric
1	xeric	6	hygric
2	subxeric	7	subhydric
3	submesic	8	hydric
4	mesic		

It is difficult to consistently and reliably assign SMR classes from air photos. However, for most polygons it should be feasible to determine the "generalized" SMR outlined on Table 4-4 and Figure 4-1, which will in turn help you decide on the relative SMR. Although the emphasis here is largely on the physical features of the landscape, vegetation species composition and vigour obviously play an important role in the SMR decision. Furthermore, the Ministry of Forests biogeoclimatic subzone and variant maps for the different forest regions in the province, in combination with the accompanying field guides for site identification, will provide practical reference information.

For land cover components where soil is not available for vascular plants to establish and grow in, the soil moisture regime field should be left blank.

As each land cover component is given a unique SMR value, it is possible that a particular polygon may have both an LCC with an SMR value and an LCC without an SMR value.

The following cover types should have a blank attribute in the SMR field:

lakes, rivers, reservoirs, salt water, glaciers, road surface (paved, not gravel), buildings and parking and airports (paved, not gravel).

Guidelines

The following guidelines can be used to aid estimation of SMR:

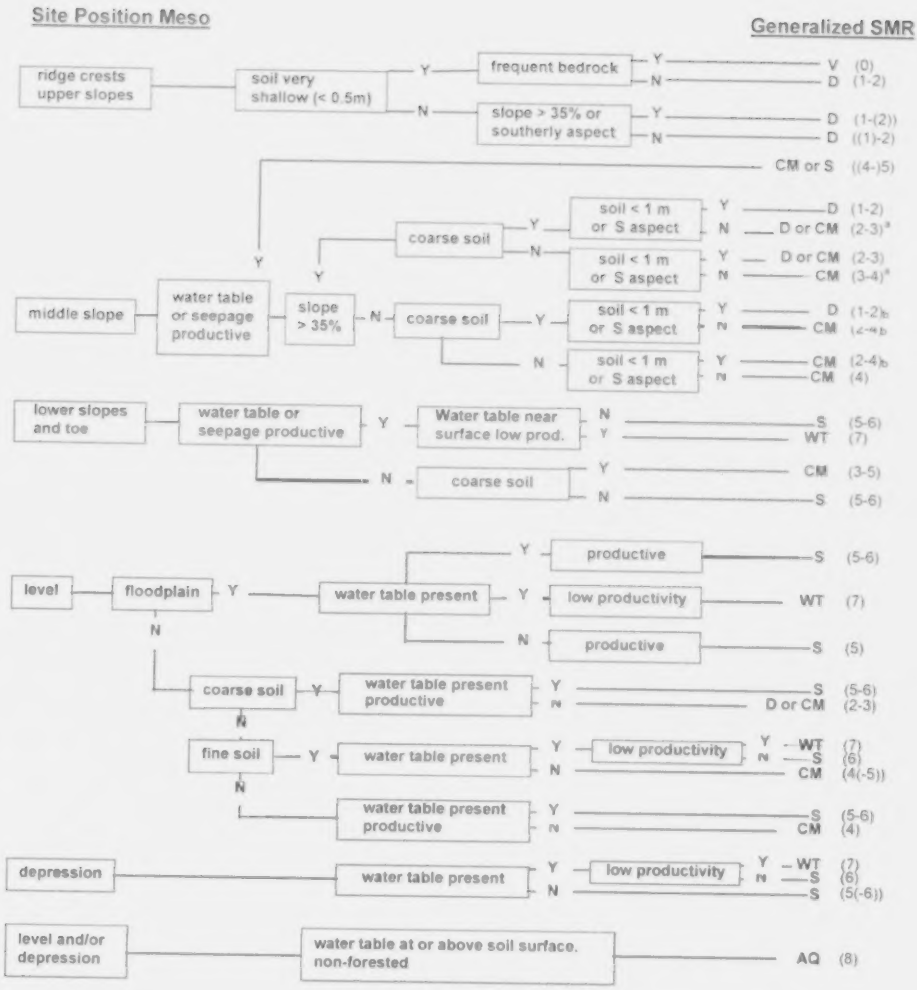
- SMR can be inferred from selected physiographic and soil features;
- SMR classes, particularly 0 to 5, do not reflect the actual amount of available water as this is a function of climate;
- SMR is based on annual water balance and water table depth;
- Very dry and dry classes represent growing season water deficits;
- Circum-mesic classes represent regimes with neither deficits nor surpluses during the growing season;
- Seepage, wet, and aqueous classes indicate growing season water surpluses, often with shallow water tables;
- Wet and aqueous classes are, by definition, "wetlands";
- SMR can be indirectly inferred using indicator plants.

Table 4-4 and Figure 4-1 will assist in the photo interpretation of SMR. Table 4-4 indicates the relationship between SMR and soil nutrient regime (SNR). It also provides assistance to the photo interpreter in determining generalized SMR.

Table 4.4 – Relative and generalized SMR and SNR Guide

SOIL MOISTURE REGIME	PRIMARY WATER SOURCE	GENERALIZED SOIL NUTRIENT REGIME						GENERALIZED SOIL MOISTURE REGIME
		P poor		M medium		R rich		
		RELATIVE SOIL NUTRIENT REGIME						
		A very poor	B poor	C medium	D rich	E very rich	F ultra-rich, saline	
VERY XERIC 0	precipitation							VERY DRY (V)
XERIC 1	precipitation							DRY (D)
SUBXERIC 2	precipitation							
SUBMESIC 3	precipitation							CIRCUM-MESIC (CM)
MESIC 4	precipitation in moderately fine-textured soils & limited seepage in coarse-textured soils							
SUBHYGRIC 5	precipitation and seepage							
HYGRIC 6	seepage							SEEPAGE (S)
SUBHYDRIC 7	seepage of permanent water table							WET (WT)
HYDRIC 8	permanent water table							AQUEOUS (AQ)

Adapted from A Field Guide for Site Identification and Interpretation for the Vancouver Forest Region, LMH 28, 1994



[a] Generally moister if aspect is N or NE

[b] Generally drier if aspect is S or SW

Adapted from A Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region, 1993.

Figure 4.1 – Key to air photo interpretation of soil moisture regime.

Examples of Land Cover Component Classification

Criteria for the delineation of land cover polygons is presented in Section 2 of this manual. Under ideal conditions, land cover can be delineated into uniform or "like" land cover communities (referred to as polygons), providing a means of attaching polygon descriptions (attributes) as well as the spatial data necessary for mapping operation. However, ideal conditions do not always occur and it is necessary to group areas of varying land cover together as a single polygon. Delineating small polygons is impractical so these distinct communities of land cover cannot be delineated as separate polygons. They can, however, be identified as separate land cover components within one polygon.

Figure 4-2 summarizes the various possibilities of classification using land cover component identification.

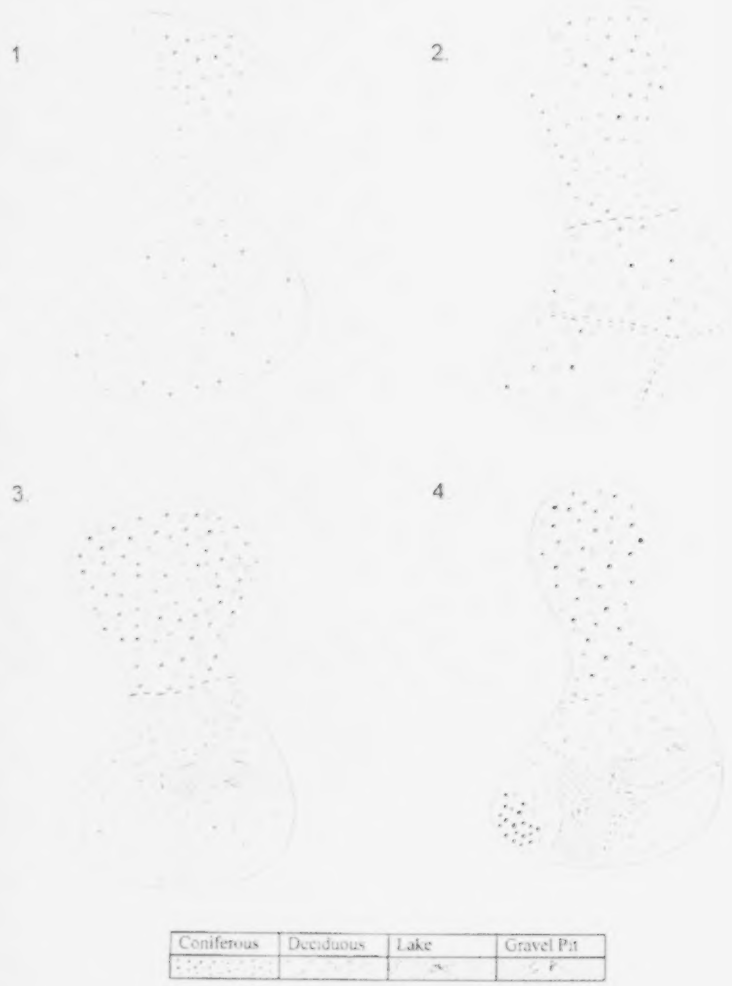


Figure 4.2 – Examples of land classification.

Table 4-5 lists the criteria used to classify each polygon example.

Table 4-5 Land classification summary

Example	LCC1	LCC1 %	SMR	LCC2	LCC2 %	SMR	LCC3	LCC3 %	SMR	Other LCCS
1	TC	100%	5	-	-	-	-	-	-	-
2	TC	50%	5	TB	50%	6	-	-	-	-
3	TM	50%	5	TB	40%	6	LA	10%	-	-
4(a)	TM	50%	5	TB	30%	6	LA	10%	-	10%
4(b)	TM	50%	5	TB	30%	6	GP	10%	0	10%

Figure 4-3 illustrates a uniform polygon of both coniferous and broadleaf tree cover. There may be a variety of land cover such as shrubs, herbs, etc., visible between the trees but since the tree crown closure exceeds 10% throughout all parts of the polygon, any land cover components identified must be treed. Since coniferous coverage (by basal area) is greater than 75% in all parts of the polygon (see Section 1 *Land Cover Classification Scheme*), it is "Treed Coniferous - TC" throughout. There is no portion of the polygon that is 10% or more by area that represents another land classification.

Figure 4.3 – Land Classification - Example #1.

This is a simple example that is typically observed in treed areas. Remember that land cover components can be identified on the basis of distinct differences in soil moisture regime within the polygon, although tree, shrub, herb, etc., cover entirely dominates the polygon. In this respect, it is possible to identify separate land cover components. As an example, assume that in Figure 4-3, two or more distinct soil moisture regimes are evident. Each component would be TC, but with different soil moisture regimes. For instance, if the upper end of the polygon is dominated by upper slope Douglas-fir and the lower part of the polygon by lower slope white spruce, there may be two land cover components identified:

1. TC 50% SMR = 5; and,
2. TC 50% SMR = 7.

The vegetation observed in the polygon should clearly reflect the presence of multiple soil moisture regimes.

In Figure 4-4, the polygon consists of both coniferous and broadleaf tree cover, as well as a small, non-vegetated area covered by roads. Two distinct communities of land cover can be identified (based on the B.C. Land Cover Classification Scheme).

Figure 4-4 - Land Classification - Example #2.

Although the road is a distinct form of land cover, it is not of a sufficient size (at least 10% of the polygon area) to be indicated as a land cover component. The description of it as a distinct land cover component is unnecessary.

All land cover visible to the photo interpreter is fully described in attributes other than land cover components and, in this example, "RP" would be included as a Non-Vegetated Cover Type (see Section 10.1) with a Non-Vegetated Cover Percent (see Section 10.2) of 4% and a Non-Vegetated Cover Pattern (see Section 10.3) of "2".

In Figure 4-5, three land cover components are observed.

3.

Figure 4.5 – Land Classification - Example #3.

The top portion of the polygon is dominated by tree cover consisting of both coniferous and broadleaf cover. Since there are no individual areas or patches of at least 10% of the polygon where either coniferous or broadleaf cover constitutes a minimum of 75% of the tree basal area, this is considered to be a "Treed Mixed - TM" cover component.

In the lower portion of the polygon, broadleaf cover dominates with a greater than 75% portion of the total basal expressed as species composition, thus, "Treed Broadleaf - TB" is the land cover component.

The lake is a distinct land cover and is considered to consist of 10% of the polygon total area. It is included as land cover component #3. The road cover is less than 10% and, although it is distinct, it is not included as an "Other Land Cover Component. " Note that both the road and the lake will need to be included as Non-Vegetated Cover (see Section 10) in the overall polygon description.

In Figure 4-6, there are several distinct land covers present.

4

Figure 4.6 – Land Classification - Example #4.

The two treed areas are identified using the same criteria discussed in the previous examples. However, this leaves only one other land cover component to be identified. The decision of whether to include the lake or the gravel pit as the third land cover component depends on the size and distinctness of the land cover in question. In this case, both are distinct and of roughly equal size. Therefore, either may be chosen (as shown in examples 4(a) and 4(b) in Table 4-5). The road is included within the "Other Land Cover Component" area. It is expected that polygons of this complexity will be infrequent and all land cover is subsequently described in the full polygon description. The land classification is a separate exercise for broad reporting capabilities, not for a single detailed polygon description.

Section 5:
Site Index Attributes

Introduction

All polygons with trees, and polygons that are potentially capable of producing trees are to be assigned site index values. Values are entered for the following attributes.

Estimated Site Index Species: species upon which the site index is based.

Estimated Site Index: site index in metres at base age 50 at DBH.

Estimated Site Index Source: source of information for site index determination.

Photo interpreters will **NOT** be responsible for estimating values in the following situations:

- polygons with trees 30 years old or greater (the site index for these stands will be derived from the tree attributes);
- regenerated stands located in silviculture openings, as the information used to generate the site index attributes will be obtained from silviculture field surveys.

Photo interpreters will be responsible for estimating values in the following situations:

- polygons with trees less than 30 years old (total age);
- polygons not in silviculture openings, with no tree cover at present, but estimated to be potentially capable of producing trees if converted to a tree crop; and,
- polygons that are occupied by trees that have been planted outside their normal ecological range or are occupied by suppressed trees that do not reflect the potential site productivity of the polygon.

The following sections describe the process of estimating site index. For more information on site index derivation, see Section 11 *Derived Attributes*.

5.1 Estimated Site Index Species

Definition

Estimated site index species is the tree species from which the site index for the polygon is derived.

Purpose

The estimate of site index species provides a link between the site index and a particular tree species site productivity (i.e., age / height curve).

Procedure

The interpreter will enter the site index species for:

- polygons with trees less than 30 years (total age);
- polygons currently non-treed but capable of producing trees; and,
- polygons occupied by trees that have been planted outside their normal ecological range or occupied by suppressed trees that do not reflect the potential site productivity of the polygon.

The interpreter will view the polygon and select the tree species that provides the best description of site productivity:

- from the existing tree species;
- from adjacent, similar stands;
- from an assessment of ecological factors; and,
- from ground information calibration points.

5.2 Estimated Site Index

Definition

Estimated site index is an estimate of site productivity for tree growth (height in metres at breast height age of 50 years).

Purpose

The estimated site index provides an estimate of the site productivity for tree species growth.

Procedure

Estimated site index may be based on the direct application of conventional site index curves, or it may be estimated from other data sources. The direct site index value may be determined from the dominant and codominant trees.

Note: Dominant trees have crowns receiving full light from above and full to partial light from the side. Codominant trees have crowns receiving full light from above and comparatively little direct light from the sides.

Alternative data sources may be used when assigning an estimated site index to:

- young stands less than 30 years (total age);
- polygons that are occupied by trees that have been planted outside of their normal ecological range or occupied by suppressed stands that do not reflect their potential site productivity; and,
- non-treed areas with or without shrub or tree cover upon which it is estimated that a tree crop could be produced.

For each category listed above, determine the most appropriate method for deriving site index.

Estimated site index is recorded to the nearest one metre.

Example:

Burned lodgepole pine area with no current tree coverage (interior stand).

Delineate denuded area (e.g., burn) into areas of similar productivity.

The estimated site index source code (for this example) is "E" Ecological Correlations (see following Estimated Site Index Source).

Using Figure 5-1, establish the polygon's relevant slope position from which the site index can be interpreted. If the polygon is in the receiving zone, the site index value is interpreted as 15 m.

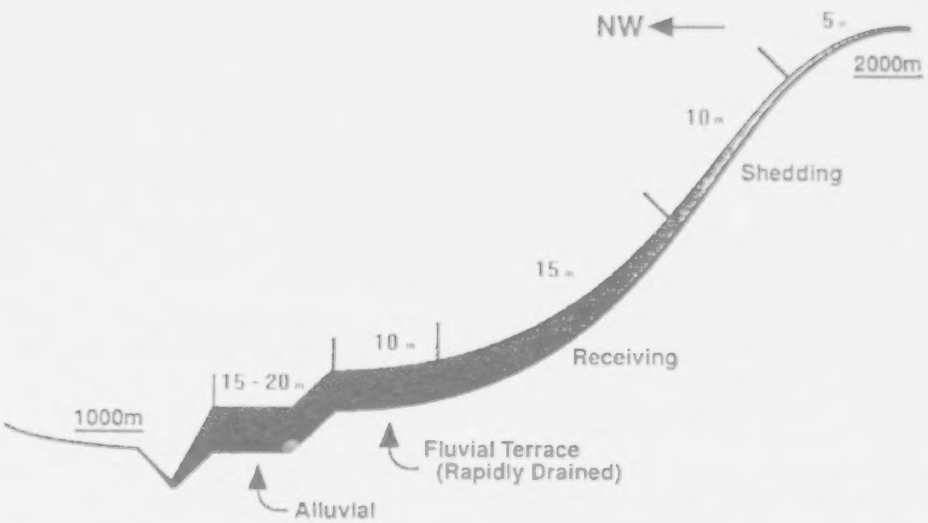


Figure 5.1 – Site productivity for pine stands in the Upper Elk Valley near Fernie.

5.3 Estimated Site Index Source

Definition

Estimated site index source indicates the method used for obtaining an estimated site index.

Purpose

The estimated site index source identifies the method by which the site index is estimated, indicates the reliability of the estimate, and classifies the sources for further analysis.

Procedure

Assign the appropriate letter code to identify the site index source (see Table 5.1).

Table 5.1 – Estimated site index source codes

Codes	Description
A	**Adjacent stand** The site index is assigned using information from adjacent stands with similar species, age and height.
E	**Ecological correlation** Using an assessment of ecological site factors and indicator plant species prior to harvest, a determination is made of an ecological classification. The classification and associated site index for various species is attained from tabular values.
H	**Historic** Derived from the site index value of the previous stand with no change to the site index value.
I	**Growth intercept** This is a field procedure carried out on stands that have at least five years growth above breast height, but are less than 30 years old. It is determined during a silvicultural survey.
S	**Silviculture section** Assigned by the District Silviculture section; when the method of determination is unknown (potential methods can be the growth intercept, ecological correlations, historic, or adjacent stands).

Section 6:
Tree Attributes

Introduction

Tree attributes are layer-specific polygon estimates. The polygon is uniquely identified and subsequent qualitative and quantitative measurements are made for the tree cover in each layer of the polygon.

This section describes the process for developing estimates for polygon attributes related to tree cover. These attributes are:

- tree cover pattern;
- tree crown closure;
- tree layer;
- vertical complexity;
- species composition;
- age (leading and second species);
- height (leading and second species);
- update year;
- basal area;
- density;
- snag frequency.

6.1 Tree Cover Pattern

Definition

Tree cover pattern describes the spatial distribution of the tree cover within each tree layer in the polygon.

Purpose

Tree cover pattern is used to describe the tree layer spatial distribution. Examples include treed islands in the subalpine parkland, clumps of trees on rocky outcrops, scattered groves or individual trees in an otherwise shrubby flood plain or solid, continuous tree cover. Tree cover pattern provides information on the amount of "edge" and "interior" habitat within the polygon.

Procedure

Enter the cover pattern code (1-9), from Figure 6-1, for the tree cover observed within the polygon. Cover pattern is based on the majority area coverage.

Cover pattern is estimated for each tree layer in the polygon. It may help to visualize all the trees without the aid of a stereoscope and interpret the cover pattern in this manner.

1. Single to very few (<4) occurrences of limited extent, circular to irregular shape.

2. Single to very few (<4) occurrences of limited extent, linear or elongated shape.

3. Several (>3) sporadic occurrences of limited extent, circular to irregular shape.

4. Several (>3) sporadic occurrences of limited extent, linear or elongated shape.

5. Intimately intermixed units, often with gradational transitions from one to the other.

6. Discontinuous but extensive occurrences, parallel to sub-parallel elongated in shape.

7. Limited continuous occurrence with few inclusions.

8. Continuous occurrence with several inclusions.

9. Continuous occurrence with very few inclusions.

Figure 6.1 – Tree cover patterns.

6.2 Tree Crown Closure

Definition

Tree crown closure is the percentage of ground area covered by the vertically projected crowns of the tree cover for each tree layer within the polygon.

Purpose

Tree crown closure provides an essential estimate of the vertical projection of tree crowns upon the ground. Since tree crown closure is very difficult to measure on the ground, this estimation by the interpreter is important.

Procedure

Record crown closure to the nearest percent for the polygon. Where vegetation is overlapping (such as a two-layer stand) only the visible portion of each layer is estimated for crown closure.

Crown closure is estimated for each tree layer in the polygon.

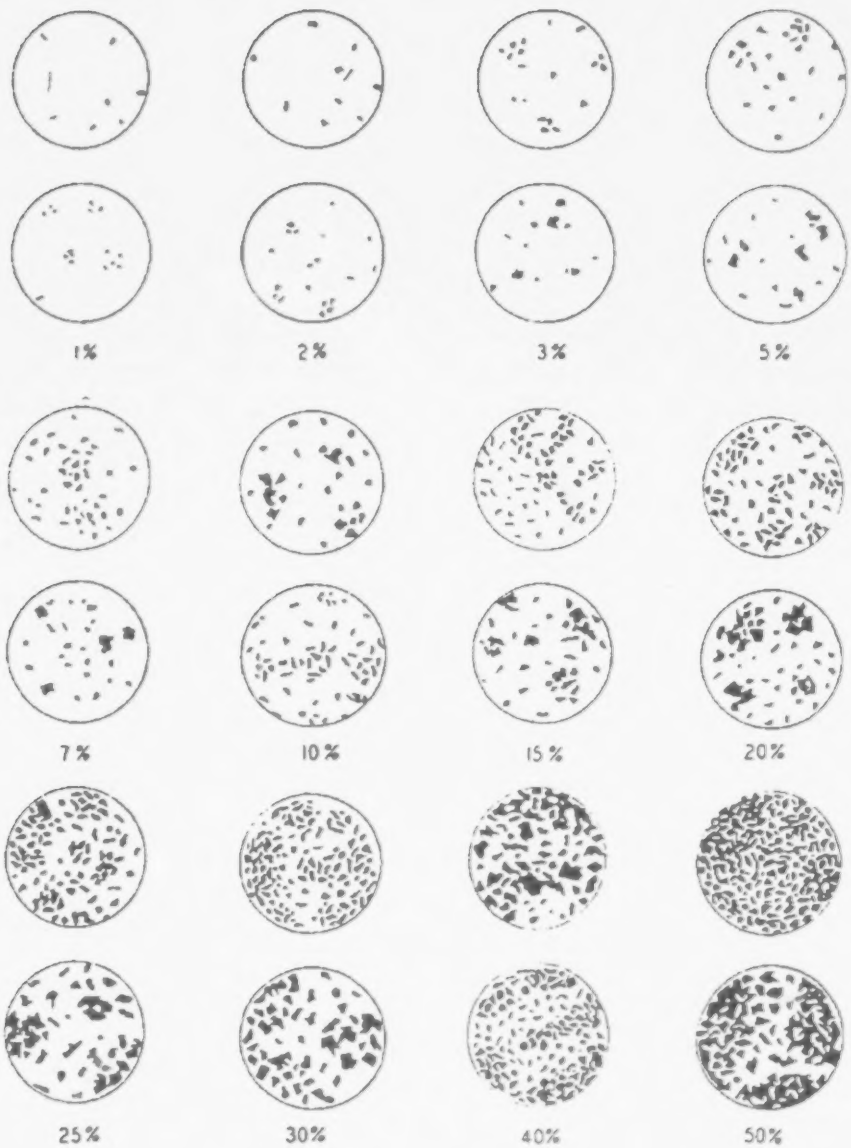
Crown closure estimation can be aided by:

- **Cover comparison charts**

  Using a stereoscope to view the photograph, select a representative part of the polygon. Compare the relative crown densities of the comparison chart (see Figure 6-2) against the representative crown closure of the polygon. Select a relative crown density that most closely matches the polygon. Read and enter the crown closure percent from the comparison chart.

- **Black and White Stereogram Handbook and Colour Stereogram Handbook**

  These handbooks have photo examples with measured crown closure values. They include 70 mm photo samples and measured photo samples that can be used as calibration values.



Developed by Richard D. Terry and George V. Chilingar. Published by the Society of Economic Paleontologist and Mineralogist in its journal of Sedimentary Petrology 25(3): 229 - 234, September 1955.

Comparison charts for Visual Estimation of Foliage Cover.

Figure 6.2 – Comparison chart for estimating cover.

6.3 Tree Layer

Definition

Tree layer is a number that identifies the tree layer being described in a multi-layered stand.

Purpose

The tree layer identification creates a link between each polygon attribute and the corresponding tree layer.

Procedure

Tree layers are distinguished according to recognized height differences which are, in many cases, associated with distinct age differences. Identification guidelines may vary, depending on each user's needs and the complexity of the project area. An example of this is a regenerated lodgepole pine stand growing under an older Douglas-fir layer after a fire.

Enter a number to identify the tree layer being described. The layer of greatest height is indicated by "1", and each subsequent height layer is identified with a larger number (e.g., the next greatest height would be "2", the next greatest would be "3", etc.).

To be classified as multi-layered, a stand should meet the following criteria:

- Each layer must be distinct and relatively homogenous throughout the type.
- Each layer should consist of different tree species except when the layer separation is distinct.
- Differences in age and height between layers should be identifiable on the aerial photograph and on the ground.
- The bottom layer is usually established following a major disturbance such as fire or logging.
- The age of the younger of the two layers should be 120 years or less. If both layers are 121 years or older, the polygon should be treated as one layer.

6.4 Vertical Complexity

Definition

Vertical complexity is a subjective classification that describes the form of each tree layer as indicated by the relative uniformity of the forest canopy as it appears on mid-scale aerial photographs. Vertical complexity is influenced by stand age, species (succession as it relates to shade tolerance) and degree and age of past disturbance. The tree height range is calculated as the total difference in height between the tallest and shortest visible dominant, codominant, and high intermediate trees. To most adequately represent the tree layer of interest, occasional occurrences of either very tall or very short trees should be ignored so that the vertical complexity indicated is for the majority of stems in the dominant, codominant, and high intermediate portion of each tree layer.

Purpose

Vertical complexity is used to identify and describe even-age and uneven-aged stands for further analysis in forest stand management and wildlife habitat assessment.

Procedure

Select the most appropriate code from Table 6-1 to best describe the vertical complexity for each tree layer in the polygon.

Example Calculation:

The following is an example of the calculation to determine the percent difference in tree height for the assignment of the Tree Vertical Complexity code. The Leading Species Height (dominant, codominant, and high intermediate trees) is 23 metres and the tree heights range from 20 to 26 metres (all species in the dominant, codominant, and high intermediate crown positions) for a total tree height range of 6 metres:

$$\text{Percent difference} = \frac{\text{Tree height range}}{\text{Height of leading species}} \times 100$$

$$= \frac{6}{23} \times 100$$

$$= 26\%$$

A difference of 26% correlates to a vertical complexity code 3 for the tree layer.

Table 6.1 – Coding for vertical complexity

Codes	Description
1	**Very uniform** *A very uniform canopy with less than 11% difference between the height of* the leading species and the average tree layer height. Holes (or canopy gaps) are generally not visible in the canopy and there is usually no evidence on the photograph of recent disturbances affecting the form of the stand. Examples include plantations and young, immature stands of shade intolerant species.
2	**Uniform** A uniform canopy with 11% - 20% difference between the height of the leading species and the average tree layer height. A few holes (or canopy gaps) may be visible in the canopy and there is usually little or no evidence on the photograph of recent disturbance affecting the form of the stand.
3	**Moderately uniform** A moderately uniform canopy with 21% - 30% difference between the height of the leading species and the average tree layer height. Some holes (or canopy gaps) may be visible in the canopy and there may be evidence of past disturbance affecting the form of the stand. Stocking may be somewhat patchy or irregular. Examples include older spruce-balsam stands.
4	**Non-uniform** A relatively non-uniform canopy with 31% - 40% difference between the height of the leading species and the average tree layer height. Holes (or canopy gaps) are often visible in the canopy (due to past disturbance) and stocking is typically patchy or irregular.
5	**Very non-uniform** A very non-uniform canopy with more than a 40% difference between the height of the leading species and the average tree layer height. Stocking is typically very patchy or irregular. Examples include disturbed dry belt Douglas-fir stands and decadent, coastal over-mature stands.

Example:

Average Tree	Tree Height Range (m) by Vertical Complexity Code				
Layer Height (m)	1	2	3	4	5
10	0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	>4.0
20	0 - 2.0	2.1 - 4.0	4.1 - 6.0	6.1 - 8.0	>8.0
30	0 - 3.0	3.1 - 6.0	6.1 - 9.0	9.1 - 12.0	>12.0
40	0 - 4.0	4.1 - 8.0	8.1 - 12.0	12.1 - 16.0	>16.0
50	0 - 5.0	5.1 - 10.0	10.1 - 15.0	15.1 - 20.0	>20.0

6.5 Species Composition

Definition

Species composition describes the tree species present and provides an estimate of the percentage of each species within the polygon. Species percent is an estimate of the percentage of live tree species occupying the polygon, based on the proportion of basal area or density.

Purpose

Species composition describes the various species of live trees that may be present in the polygon and provides an estimate of the percentage of each species to the nearest percent. Species composition can be used for volume derivation.

Procedure

Identify the tree species present in the polygon and list them in descending order. Up to six different species may be identified. Estimate species composition for each tree layer in the polygon.

For each species identified, estimate the species composition to the nearest one percent for all living trees of that species in the polygon based on density or basal area occupancy.

- If the height of the dominant, codominant and high intermediate trees is greater than or equal to two metres, the estimate is based on basal area occupancy (square metres per hectare).
- If the height of the dominant, codominant and high intermediate trees is less than two metres, the estimate is based on density (stems per hectare).

> **Note:** Dominant trees have well-developed crowns that extend above the general level of the trees around them. Codominant trees have crowns forming the general level of trees around them. High intermediate trees have smaller crowns slightly below but extending into the general level of trees around them.

The interpreter normally estimates the overall stand basal area first. Then this value is split into individual estimates for each species. Species composition based on basal area is strongly correlated with species composition based on volume. Studies have shown that volume and basal area correspond quite well, except for some species. Cedar has a larger basal area in proportion to its volume, and spruce has a smaller basal area in proportion to its volume.

The tools used to make these interpretations are stereograms, ground calibration points, ecological site descriptions, and local knowledge. These interpretations are tempered by knowledge of species heights, crown shapes, and other factors.

Species composition must add up to 100%.

It is important to establish the correct percentages for the leading species, as the stand age, height, and site index are usually determined from the leading species.

In some instances the interpreter will be able to identify the genera (e.g., *Abies*) but not be able to identify the specific species (e.g., *Abies amabalis* or *Abies grandis*). In these instances only the genera should be identified. The level of identification may vary depending on the user's needs and the complexity of the project area. The objective of the inventory is to identify the species accurately, wherever possible. Acceptable genus and species codes are listed in Table 6-2.

Table 6.2 – Acceptable tree genus and species codes and common names

Common Name	Scientific Name	Codes	
NATIVE CONIFERS			
Cedar	***Thuja***	**C**	
western redcedar	*Thuja plicata*		Cw
Cypress	***Chamaecyparis***	**Y**	
yellow-cedar	*C. nootkatensis*		Yc
Douglas-fir	***Pseudotsuga***	**F**	
Douglas-fir	*P. menziesii*		Fd
coastal Douglas-fir	*P. menziesii* var. *menziesii*		Fdc
interior Douglas-fir	*P. menziesii* var. *glauca*		Fdi
Fir (Balsam)	***Abies***	**B**	
amabilis fir	*A. amabilis*		Ba
grand fir	*A. grandis*		Bg
subalpine fir	*A. lasiocarpa*		Bl
Hemlock	***Tsuga***	**H**	
mountain hemlock	*T. mertensiana*		Hm
western hemlock	*T. heterophylla*		Hw
mountain x western hemlock hybrid	*T. mertensiana* x *heterophylla*		Hxm
Juniper	***Juniperus***	**J**	
Rocky Mtn. juniper	*J. scopulorum*		Jr
Larch	***Larix***	**L**	
alpine larch	*L. lyallii*		La
tamarack	*L. laricina*		Lt
western larch	*L. occidentalis*		Lw
Pine	***Pinus***	**P**	
jack pine	*P. banksiana*		Pj
limber pine	*P. flexilis*		Pf
lodgepole pine	*P. contorta*		Pl
lodgepole pine	*P. contorta* var. *latifolia*		Pli
lodgepole x jack pine hybrid	*P.* x *murraybanksiana*		Pxj

Common Name	Scientific Name	Codes	
ponderosa pine	*P. ponderosa*		Py
shore pine	*P. contorta* var. *contorta*		Plc
western white pine	*P. monticola*		Pw
whitebark pine	*P. albicaulis*		Pa
Spruce	***Picea***	**S**	
black spruce	*P. mariana*		Sb
Engelmann spruce	*P. engelmannii*		Se
Sitka spruce	*P. sitchensis*		Ss
white spruce	*P. glauca*		Sw
spruce hybrid	*Picea* cross		Sx
Engelmann x white	*P. engelmannii* x *glauca*		Sxw
Sitka x white	*P.* x *lutzii*		Sxl
Sitka x unknown hybrid	*P. sitchensis* x ?		Sxs
Yew	***Taxus***	**T**	
western yew	*Taxus brevifolia*		Tw
NATIVE HARDWOODS			
Alder	***Alnus***	**D**	
red alder	*A. rubra*		Dr
Apple	***Malus***	**U**	
Pacific crab apple	*Malus fusca*		Up
Aspen, Cottonwood or Poplar	***Populus***	**A**	
poplar	*P. balsamifera*		Ac
balsam poplar	*P. b.* ssp. *balsamifera*		Acb
black cottonwood	*P. b.* ssp. *trichocarpa*		Act
hybrid poplars	*P.* spp.		Ax
trembling aspen	*P. tremuloides*		At
Arbutus	***Arbutus***	**R**	
Arbutus	*Arbutus menziesii*		Ra
Birch	***Betula***	**E**	
Alaska paper birch	*B. neoalaskana*		Ea
Alaska x paper birch hybrid	*B.* x *winteri*		Exp
paper birch	*B. papyrifera*		Ep
water birch	*B. occidentalis*		Ew
Cascara	***Rhamnus***	**K**	
cascara	*R. purshiana*		Kc
Cherry	***Prunus***	**V**	

Common Name	Scientific Name	Codes	
bitter cherry	*P. emarginata*		Vb
choke cherry	*P. virginiana*		Vv
pin cherry	*P. pensylvanica*		Vp
Dogwood	***Cornus***	**G**	
Pacific dogwood	*Cornus nuttallii*		Gp
Maple	***Acer***	**M**	
bigleaf maple	*A. macrophyllum*		Mb
vine maple	*A. circinatum*		Mv
Oak	***Quercus***	**Q**	
Garry oak	*Q. garryana*		Qg
Willow	***Salix* spp.**	**W**	
Bebb's willow	*S. bebbiana*		Wb
Pacific willow	*S. lucida*		Wp
peachleaf willow	*S. amygdaloides*		Wa
pussy willow	*S. discolor*		Wd
Scouler's willow	*S. scouleriana*		Ws
Sitka willow	*S. sitchensis*		Wt
UNKNOWNS			
Unknown		**X**	
Unknown conifer			Xc
Unknown hardwood			Xh
OTHERS			
Other tree, not on list		**Z**	
Other conifer			Zc
Other hardwood			Zh
EXOTICS			
Apple	*Malus*	**U**	
apple	*Malus pumila*		Ua
Aspen, Cottonwood or Poplar	***Populus***	**A**	
*southern cottonwood	*P. deltoides*		Ad
Birch	***Betula***	**E**	
European birch	*B. pendula*		Ee
silver birch	*B. pubescens*		Es

Common Name	Scientific Name	Codes	
Cherry	*Prunus*	V	
sweet cherry	*P. avium*		Vs
Cypress	*Chamaecyparis*	Y	
*Port Orford-cedar	*C. lawsoniana*		Yp
Fir (Balsam)	*Abies*	B	
*balsam fir	*A. balsamea*		Bb
noble fir	*A. procera*		Bp
*Shasta red fir	A. magnifica var. shastensis		Bm
*white fir	A. concolor		Bc
Maple	*Acer*	M	
box elder	*A. negundo*		Me
*Norway maple	*A. platanoides*		Mn
*Sycamore maple	*A. pseudoplatanus*		Ms
Other exotics			
*incense-cedar	Calocedrus decurrens		Oa
*giant sequoia	*Sequoiadendron giganteum*		Ob
*coast redwood	*Sequoia sempervirens*		Oc
European mountain-ash	*Sorbus aucuparia*		Od
Siberian elm	*Ulmus pumila*		Oe
common pear	*Pyrus communis*		Of
Oregon ash	*Fraxinus latifolia*		Og
Pine	*Pinus*	P	
*Monterey pine	*P. radiata*		Pm
*red pine	*P. resinosa*		Pr
*sugar pine	*P. lambertiana*		Ps
Oak	*Quercus*	Q	
*English oak	*Q. robur*		Qe
Spruce	*Picea*	S	
*Norway spruce	*P. abies*		Sn

6.6 Age of Leading Species - Age of Second Species

Definition

Age is an average age, weighted by basal area, of the dominant, codominant and high intermediate trees for the leading and second species of each tree layer identified.

Note: Dominant trees have well developed crowns that extend above the general level of the trees around them. Codominant trees have crowns forming the general level of trees around them. High intermediate trees have smaller crowns slightly below but extending into the general level of trees around them.

Purpose

The age attributes describe the age of the leading and second tree species to the nearest year.

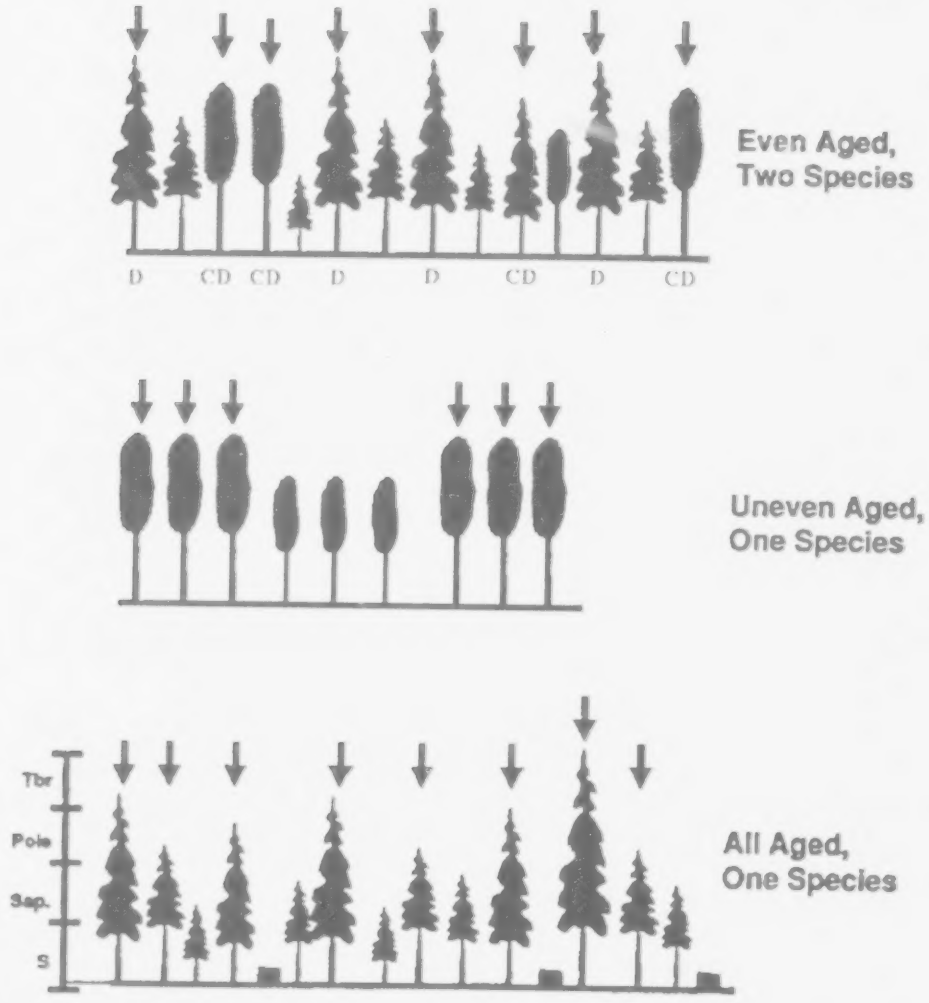
Procedure

Procedures for age estimation are for average age of dominant, codominant and high intermediate trees. A relationship between these estimates and top height may be derived, but, a photo estimation process to directly estimate top height is not practical.

Begin age estimation by estimating the species composition for the layer to determine the leading and second species. Estimate the average age, to the nearest year, of the dominant, codominant and high intermediate trees:

- for the leading species, in each tree layer identified; and,
- for the second species in each tree layer identified.

Recall that species composition is determined on the basis of basal area or density (see Section 6.5). Figure 6-3 illustrates the selection of dominant, codominant and high intermediate trees for age and height estimations.



Note: Third figure is of a selectively logged interior dry belt stand. Arrows indicate trees included for age (and height) estimation.

Figure 6.3 – Selection of dominant, codominant and high intermediate trees for age and height estimations.

The following data can be collected and used to aid in the photographic interpretation of tree age within a polygon:

- history of origin (previous surveys, silviculture);
- field measurements (for calibration, verification);
- age-height-site relationships; and,
- age patterns.

Other aids are shown in Table 6-3 below.

Table 6.3 – Aids to photo interpretation of age

Photo Characteristics	Immature	Mature
Stand texture	Even	Coarse (often crown openings are present)
Crown size on species	Narrow	Wide (varies dependent on species)
Height (height variation)	Minor	Variable
Height (size)	Less than maximum	Equals maximum per site
Snag frequency	Few	Increasing
Presence and height of successional species	None	Common, one example is spruce under aspen
Presence of short-lived pioneer species	Present	Reduced occurrence around 120 years.

Examples:

History of origin:

Figure 6.4 – The use of history information for age determination.

- Large wildfire in 1938. The ages of successional stands should be consistent throughout the burn.

6.7 Height of Leading Species - Height of Second Species

Definition

Height is an average height, weighted by basal area, of the dominant, codominant and high intermediate trees for the leading and second species of each tree layer identified.

Note: Dominant trees have well developed crowns that extend above the general level of the trees around them. Codominant trees have crowns forming the general level of trees around them. High intermediate trees have smaller crowns slightly below but extending into the general level of trees around them.

Purpose

An estimate of height is used to describe the height of the leading and second tree species to the nearest tenth of a metre.

Procedure

Procedures for height estimation are for average height of dominant, codominant and high intermediate trees. A relationship between these estimates and top height may be derived, but, a photo estimation process to directly estimate top height is not practical.

Begin by estimating species composition for the tree layer to determine the leading and second species. Estimate average height, to the nearest tenth of a metre, of the dominant, codominant and high intermediate trees:

- for the leading species, for each tree layer identified; and,
- for the second species, for each tree layer identified.

Recall that species composition is determined on the basis of basal area or density (see Section 6.5).

Height adjustments

Consider making height adjustments for the following situations.

For species with narrow crowns as the crowns do not resolve on the photograph where the crown width is less than one metre (e.g., narrow crowned alpine fir or rapidly growing coniferous). Adjust height upwards by 1 to 6 metres as illustrated in Figure 6-5.

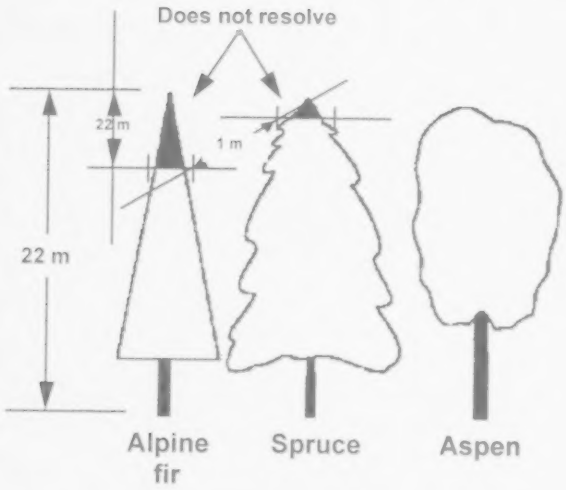


Figure 6.5 – Resolution of tree crowns.

For high-elevation stands, heights appear taller than they actually are. As an example, for a tree of the same height, differential parallax increases with elevation at the rate of 7m/1000 m (see Figure 6-6).

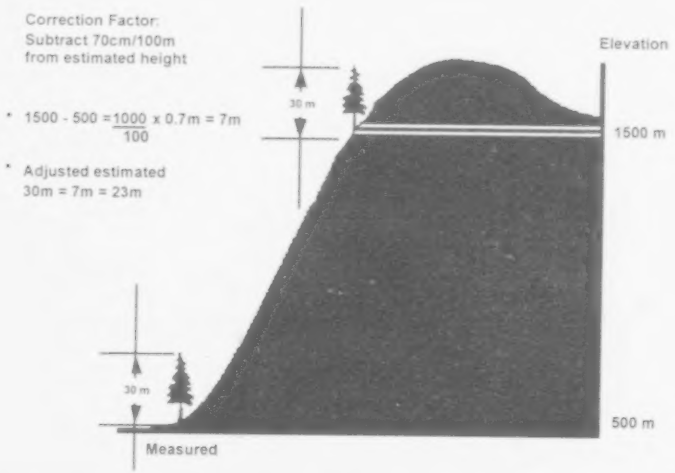


Figure 6.6 – Height adjustment for elevation difference.

6.8 Update Year

Definition

Update year is the year, after year of photography, that an update or revision has occurred to the age or height of the leading tree species in the layer of the polygon. These fields will only be used after the initial inventory has been completed.

Purpose

Update year provides a mechanism to revise or update the original information indicated for the layer of the polygon as a result of a disturbance or field verification of the data.

Procedure

These fields are only to be used after the initial inventory has been completed and are more pertinent in the update process. They are not intended to be used as a reference year - the interpreter is responsible for projecting previous data sources to the year of photography for all inventory projects.

6.9 Basal Area

Definition

Basal area is the total cross sectional area, at breast height, of all living trees visible to the photo interpreter in the dominant, codominant and high intermediate crown positions for each tree layer in the polygon. Basal area is expressed as square metres per hectare.

Note: Dominant trees have well developed crowns that extend above the general level of the trees around them. Codominant trees have crowns forming the general level of trees around them. High intermediate trees have smaller crowns slightly below but extending into the general level of trees around them.

Purpose

Basal area provides an estimate of polygon basal area per hectare and is used for the determination of species composition and timber volume.

Procedure

The polygon is visually conceived as a whole. This impression is converted to basal area (square metres per hectare) by estimating stand structure, species composition, form factors, height by species, stems per hectare, site and uniformity. The following is a suggested approach to estimating these factors:

1. Estimate the basic stand attributes for the polygon: vertical complexity, layer, species composition, age, height, and crown closure.
2. Select representative areas of the polygon.
3. Estimate the basal area for all living trees in the polygon, for each tree layer, to the nearest square metre per hectare.

   For stands with an average height of less than two metres, the basal area will likely be zero square metres per hectare.

To maintain consistency, interpreters are to concentrate their interpretation on the portion of the stand visible on mid-scale aerial photographs.

Example:

The following is an example of a low-density polygon with 1,000 trees per hectare with an average DBH of four centimetres. To calculate the basal area:

$$\text{Basal area} = \frac{\text{Average DBH area}}{\text{1 stem}} \times \text{number of stems per hectare}$$

$$= \frac{\pi r^2}{\text{1 stem}} \times \text{density (stems per hectare)}$$

$$= \frac{(3.14)\,(0.02\ \text{m})^2}{\text{1 stem}} \times \text{1000 stems per hectare}$$

$$= 1.256\ \text{m}^2 \text{ per hectare}$$

Some suggested methods for estimation are:

- **Direct estimate**: based on local knowledge and calibration points. Care must be taken in using calibration points as many of these have used various diameter limits in calculating the basal area; factor this into the interpretation.
- **Indirect estimate:** based on a comparison of the target area against a field verified stereogram that represents similar stand characteristics. Adjust the stereogram basal area to account for local variations.

Tips:

Basal area, combined with height, is highly correlated with stand volume and varies by site and stand density.

- The number of trees per hectare and diameter contribute most to basal area variation.
- Basal area increases with age and levels off or may even drop as the stand matures.

6.10 Confidence Indices

Definition

Confidence indices are a subjective value that reflect confidence of the photo interpreter in the estimation of age, height and basal area for each layer.

Purpose

Confidence indices were intended to provide a mechanism for the photo interpreter to influence the amount of adjustment applied to a polygon attribute after the ground sampling had taken place. Other means are being investigated to provide this mechanism.

Confidence indices are no longer required as a photo interpreted attribute; however, the fields in the data structure will be maintained to provide a location to influence the amount of adjustment should this be desired.

6.11 Density

Definition

Density is the average number of living trees visible to the photo interpreter in the dominant, codominant and high intermediate crown positions in each tree layer in the polygon. Density is expressed as stems per hectare.

Note: Dominant trees have well developed crowns that extend above the general level of the trees around them. Codominant trees have crowns forming the general level of trees around them. High intermediate trees have smaller crowns slightly below but extending into the general level of trees around them.

Purpose

Density provides a direct estimate of tree stems per hectare.

Procedure

The following is a suggested approach to estimating density:

1. Estimate the basic stand attributes for the polygon: vertical complexity, layer, species composition, age, height and crown closure.
2. Select representative areas of the polygon.
3. Estimate the density of trees in the polygon for each tree layer to the nearest stem per hectare when practical.

Some suggested methods of estimation are:

- **Direct estimate**: based on local field experience and photo calibration points. Care must be taken in using calibration points as many of these have used various diameter limits in calculating tree density; factor this into the interpretation.
- **Indirect estimate:** based on a comparison of the target area against a field verified stereogram that represents similar stand characteristics. Adjust the stereogram density to account for local variations.
- **Variable Density Yield Prediction (VDYP)**: for baseline estimates compare the target area against a VDYP predicted density for the species composition, age, site and crown closure. Adjust the VDYP predicted density to account for local variations.

  Note: Variable Density Yield Prediction is a method, based on empirical data, of calculating mensurational data (primarily stand volume and tree diameter) from photo interpreted data (such as species composition, age, height, crown closure).

6.12 Snag Frequency

Definition

Snag frequency is defined as the number of standing dead trees visible to the photo interpreter in the dominant, codominant and high intermediate crown positions in each tree layer. Snag frequency is expressed as stems per hectare for each tree layer.

Note: Dominant trees have well developed crowns that extend above the general level of the trees around them. Codominant trees have crowns forming the general level of trees around them. High intermediate trees have smaller crowns slightly below but extending into the general level of trees around them.

Purpose

The snag frequency provides a direct estimate of snags per hectare that can be used for wildlife and fire management and provides information for danger tree assessment.

Procedure

The following is a suggested approach to estimating snag frequency:

1. Select representative areas of the polygon.
2. Estimate the number of snags per hectare for each tree layer in the polygon.

Some suggested methods of estimation are:

- **Direct estimate**: direct count of visible snags with the aid of calibrated overlay grids.
- **Indirect estimate**: compare target area against a field verified stereogram that represent similar stand characteristics.

Note: Old-growth stands, particularly with cedar or cypress stems, may show numerous dead (whitish) tops that will appear as snags but are actually living trees.

Section 7: Shrub Attributes

Introduction

This set of attributes describes the portion of shrub cover within the polygon that is not obscured under the vertical projection of tree crown cover. Shrubs are generally multi-stemmed or non-erect woody plant species. Shrubs do not include species previously identified as trees, or those low woody plants and intermediate life forms referred to in Table 4.1 of *Describing Ecosystems in the Field*, H. Luttmerding et al., MOE Manual 11, Dec. 1990.

7.1 Shrub Height

Definition

Shrub height is the average height, in tenths of a metre, of all shrubs within the polygon.

Purpose

Shrub height describes the average height of shrub species, to the nearest tenth of a metre. When multiplied by shrub cover, an index of shrub volume is obtained that indicates available browse.

Procedure

Estimate the average height in metres (weighted by crown closure) of all shrubs within the polygon that are not obscured by tree crown cover.

Example:

Where you have two distinct shrub species, of two distinct heights, within one polygon:

Shrub Species	Height	Crown Closure
A	1.0 m	30%
B	5.0 m	20%
A, B weighted average =	2.6 m	50%

Note: The height of shrubs less than two metres is particularly important to wildlife and range managers as this represents the critical threshold for availability of browse.

7.2 Shrub Crown Closure

Definition

Shrub crown closure is the percentage of ground area covered by the vertically projected crowns of the shrub cover visible to the photo interpreter. Shrub crown closure is expressed as a percentage of the entire polygon.

Purpose

Shrub crown closure provides a direct estimate of crown closure that is not adjusted by the Ground Sampling.

Procedure

Estimate crown closure for all shrub species based on the percentage of ground area covered by the vertically projected crowns of shrubs. Only those shrubs not otherwise obscured by tree crown cover are recorded. Record crown closure to the nearest percent. No overlap of vegetation is considered for crown closure estimation.

Where different cover types occur, the following procedures may be used:

- Weight the crown closure estimate by the specific cover types. For example:
  - shrub land cover component (60% of area) has crown closure (CC) of 80% for shrubs;
  - herb land cover component (40% of area) has crown closure of 10% for shrubs.

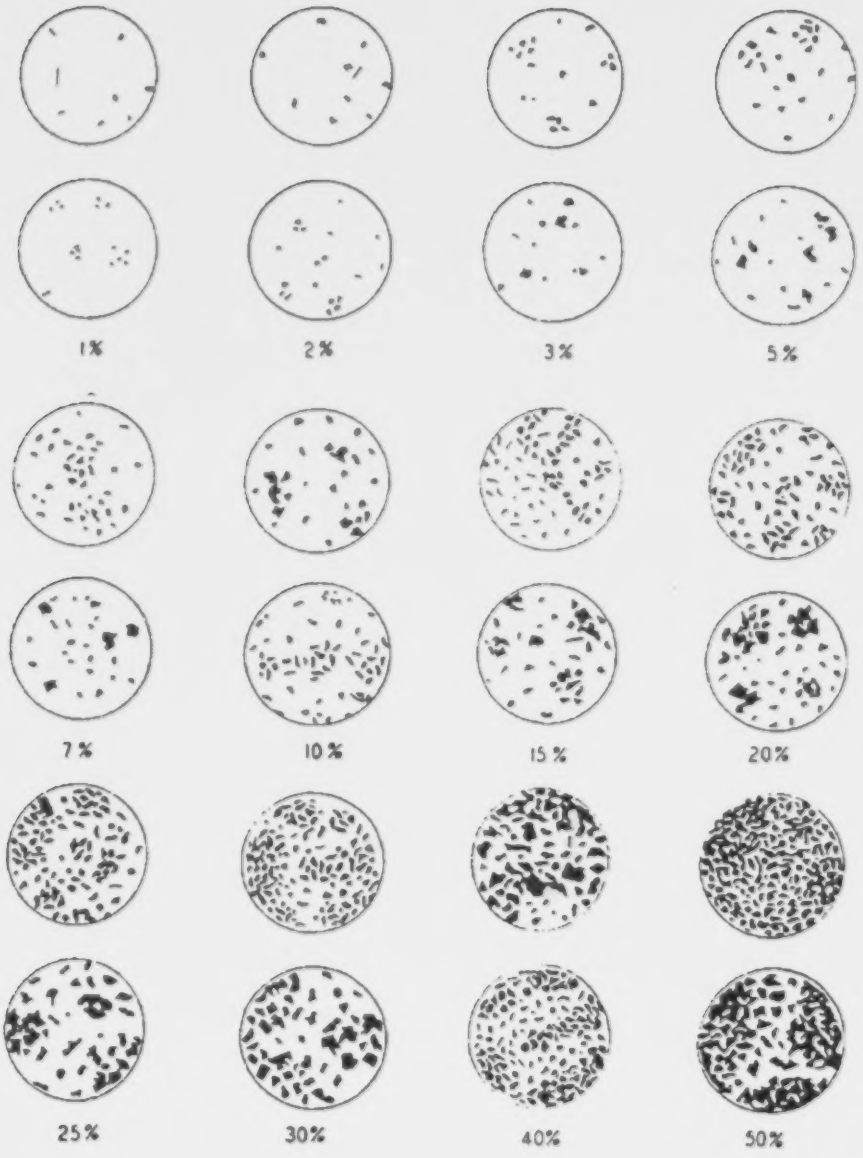
  Therefore:

  - (60% x 80% CC) + (40% x 10% CC)

    = 52% shrub crown closure for the polygon.

The following methodology will assist in the estimation of shrub crown closure:

- Under stereoscopic viewing, select a representative part of the polygon.
- Compare the relative crown densities of the **cover comparison chart** (see Figure 7-1) against the representative crown closure of the polygon.
- Select a relative crown density that most closely matches the polygon; enter the crown closure percent from the comparison chart.



Developed by Richard D. Terry and George V. Chillinger. Published by the Society of Economic Paleontologist and Minerologist in its journal of Sedimentary Petrology 25(3): 229 - 234, September 1955.

Comparison charts for Visual Estimation of Foliage Cover.

Figure 7-1 Comparison chart for estimating cover percent.

7.3 Shrub Cover Pattern

Definition

Shrub cover pattern is a code that describes the spatial distribution of the shrubs within the polygon.

Purpose

Shrub cover pattern is used to describe the shrub layer spatial distribution. Examples include clumps of shrubs on rocky outcrops, scattered patches or individual shrubs or solid, continuous shrub cover.

Procedure

Enter the cover pattern code (1-9) for shrub cover within the polygon, from Figure 7-2. Shrub cover pattern is based on the majority area coverage.

1. Single to very few (<4) occurrences of limited extent, circular to irregular shape.
2. Single to very few (<4) occurrences of limited extent, linear or elongated shape.
3. Several (>3) sporadic occurrences of limited extent, circular to irregular shape.
4. Several (>3) sporadic occurrences of limited extent, linear or elongated shape.
5. Intimately intermixed units, often with gradational transitions from one to the other.
6. Discontinuous but extensive occurrences, parallel to sub-parallel elongated in shape.
7. Limited continuous occurrence with few inclusions.
8. Continuous occurrence with several inclusions.
9. Continuous occurrence with very few inclusions.

Figure 7.2 – Shrub cover patterns.

Section 8:
Herb Attributes

Introduction

This set of attributes describes the portion of herb cover that is not obscured by the vertical projection of the crowns of either trees or shrubs.

Herbs are defined as non-woody (vascular) plants, including graminoids (sedges, rushes, grasses), forbs (ferns, club mosses, and horsetails) and some low, woody species and intermediate life forms identified in Table 4.1 of *Describing Ecosystems in the Field*, H. Luttmerding et al., MOE Manual 11, Dec. 1990.

8.1 Herb Cover Type

Definition

Herb cover types are the designations for herb-dominated areas as listed in the B.C. Land Cover Classification Scheme.

Purpose

Herb cover types will provide detailed reporting for herbaceous land cover.

Procedure

Enter the appropriate code from Table 8-1, to the level of resolution that can be photo interpreted for all herbaceous cover types observable in the polygon.

Table 8.1 – Coding for herb cover type

Codes	Description
HE	**Herb** A Herb polygon with no distinction between forbs and graminoids
HF	**Herb - Fords** A Herb polygon with forbs greater than 50% of the herb cover.
HG	**Herb - Graminoids** A Herb polygon with graminoids greater than 50% of the herb cover.

8.2 Herb Cover Percent

Definition

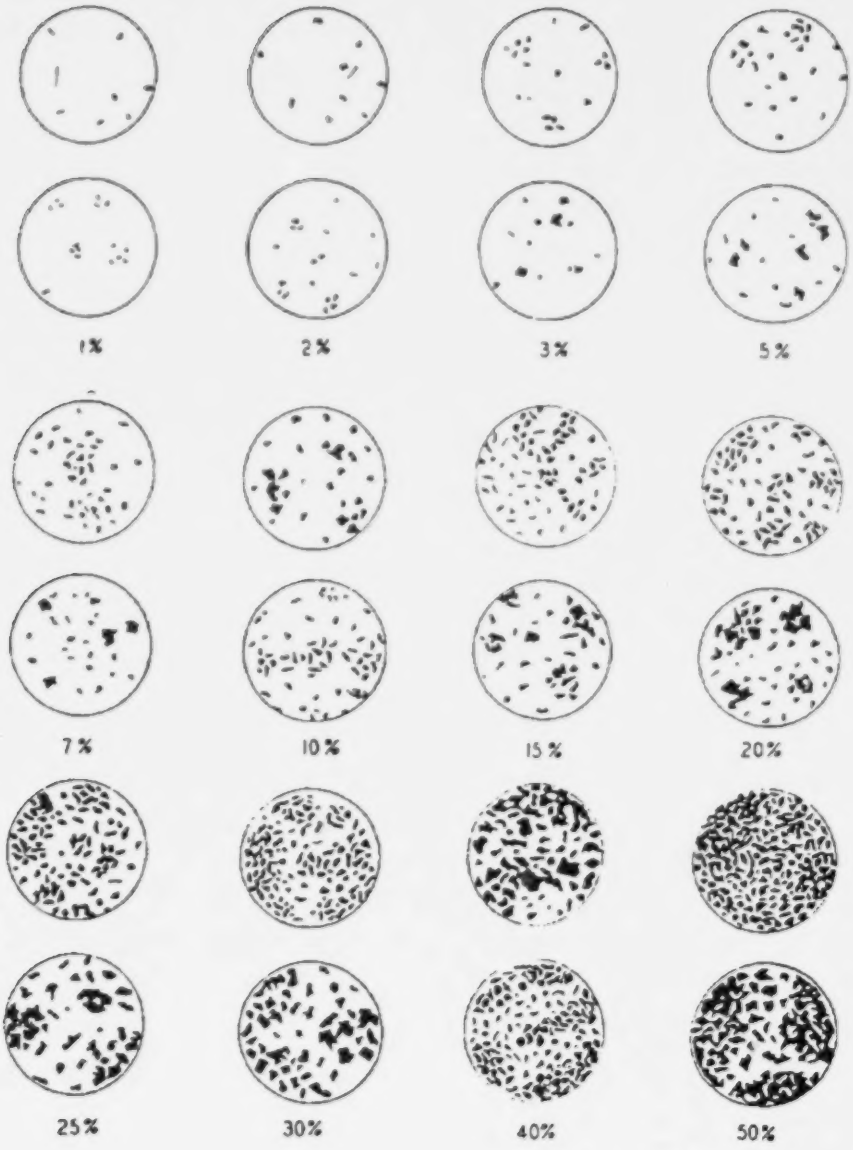
Herb cover percent is the percentage of ground area covered by herbaceous cover visible to the photo interpreter. Herb cover percent is analogous to tree and shrub crown closures and is expressed as a percentage of the entire polygon.

Purpose

Herb cover percent provides a direct estimate of herbaceous cover.

Procedure

Estimate herbaceous cover based on the percentage of ground area covered by the herbs (see Figure 8-1). Record herbaceous cover to the nearest percent.



Developed by Richard D. Terry and George V. Chillinger. Published by the Society of Economic Paleontologist and Minerologist in its journal of Sedimentary Petrology 25(3): 229 - 234. September 1955.

Comparison charts for Visual Estimation of Foliage Cover.

Figure 8.1 – Comparison chart for estimating cover percent.

8.3 Herb Cover Pattern

Definition

Herb cover pattern is a code which describes the spatial distribution of the herbaceous cover within a polygon.

Purpose

Herb cover pattern is used to describe the herb layer spatial distribution. Examples include herbaceous cover on rocky outcrops or patches of herbaceous cover within shrub-dominated polygons.

Procedure

Enter the cover pattern code (1-9) for herbaceous cover within the polygon, from Figure 8-2. Herb cover pattern is based on the majority area coverage.

1. Single to very few (<4) occurrences of limited extent, circular to irregular shape.
2. Single to very few (<4) occurrences of limited extent, linear or elongated shape.
3. Several (>3) sporadic occurrences of limited extent, circular to irregular shape.
4. Several (>3) sporadic occurrences of limited extent, linear or elongated shape.
5. Intimately intermixed units, often with gradational transitions from one to the other.
6. Discontinuous but extensive occurrences, parallel to sub-parallel elongated in shape.
7. Limited continuous occurrence with few inclusions.
8. Continuous occurrence with several inclusions.
9. Continuous occurrence with very few inclusions.

Figure 8.2 – Herb cover patterns.

Section 9: Bryoid Attributes

Introduction

This set of attributes describes the portion of bryoid cover that is not obscured by the vertical projection of the crowns of either trees, shrubs, or herbs.

Bryoids include mosses, liverworts, hornworts, and non-crustose lichens.

9.1 Bryoid Cover Percent

Definition

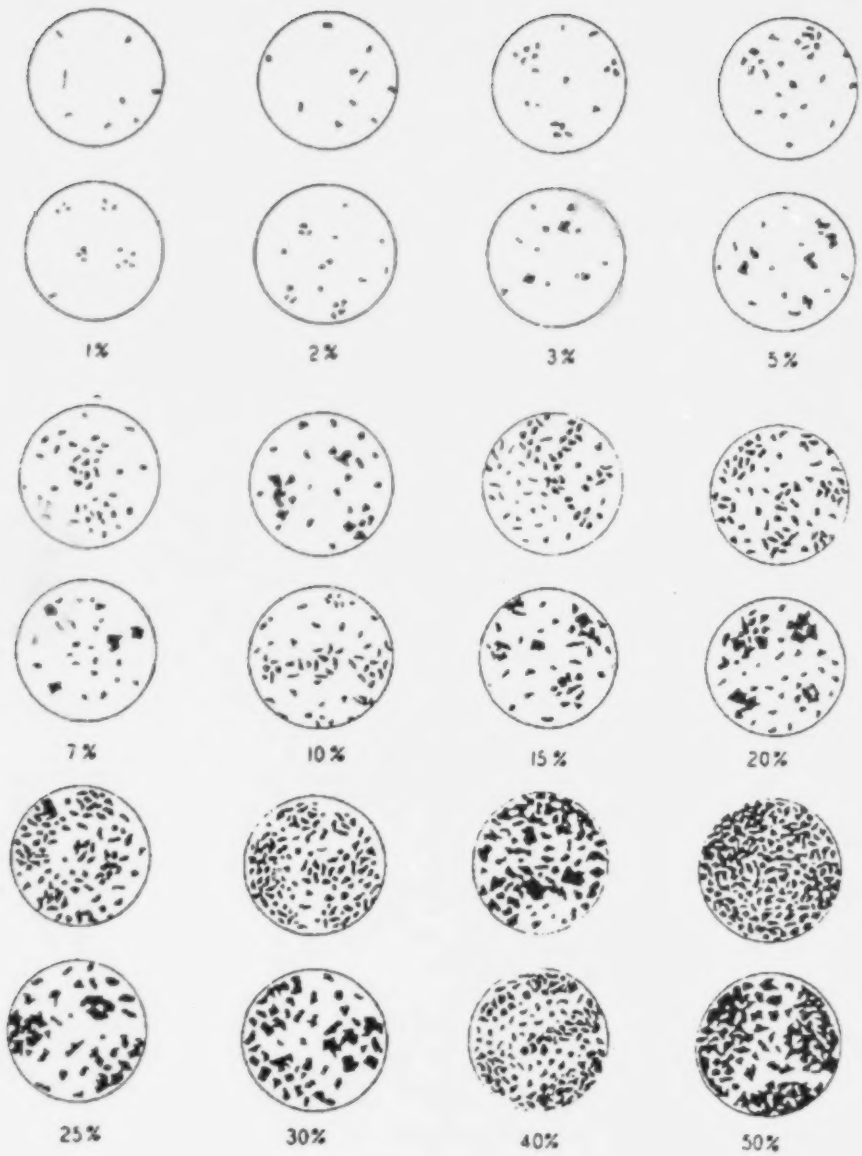
Bryoid cover percent is the percentage of ground area covered by bryoids visible to the photo interpreter. Bryoid cover percent is expressed as a percentage of the entire polygon.

Purpose

Bryoid cover percent provides a direct estimate of bryoid cover.

Procedure

Estimate bryoid cover based on the percentage of ground area covered by bryoids that are not obscured by taller life forms (see Figure 9-1). Record bryoid cover to the nearest percent.



Developed by Richard D. Terry and George V. Chillinger. Published by the Society of Economic Paleontologist and Mineralogist in its Journal of Sedimentary Petrology 25(3): 229 - 234, September 1955.

Comparison charts for Visual Estimation of Foliage Cover.

Figure 9.1 – Comparison chart for estimating cover percent.

Section 10:
Non-Vegetated Attributes

Introduction

This set of attributes describes the portion of the polygon that is non-vegetated (vegetation cover is less than 5% of the total surface area of the polygon) and is not obscured by vegetation or shadows.

10.1 Non-Vegetated Cover Type(s)

Definition

Non-vegetated cover types are the designations (from level 5 of the B.C. Land Cover Classification Scheme) for all observable non-vegetated land cover within the polygon.

Purpose

Non-vegetated cover types provide detailed reporting for non-vegetated land cover.

Procedure

Enter the appropriate code (see Table 10.1) to the level of resolution that can be photo interpreted for all non-vegetated cover types observable within the polygon. If more than one non-vegetated cover type is identified, use additional rows on the attribute form or in the database, as required.

Table 10.1 – Codes for non-vegetated cover

CODES	DESCRIPTION
	Land Cover
GL	**Glacier** A mass of perennial snow and ice with definite lateral limits, typically flowing in a particular direction.
PN	**Snow Cover** Snow or ice that is not part of a glacier but is found during summer months on the landscape.
BR	**Bedrock** Unfragmented, consolidated rock, contiguous with underlying material.
TA	**Talus** Rock fragments of any size accumulated on or at the foot of slopes as a result of successive rock falls. This is a type of colluvium.
BI	**Blockfield** Blocks of rock derived from the underlying bedrock by weathering and / or frost heaving. These have not undergone any significant down slope movement as they occur on level or gently sloping areas.
MZ	**Rubbly Mine Spoils** Discarded overburden or waste rock, moved to extract ore during mining.
LB	**Lava Bed** An area where molten rock has flowed from a volcano or fissure and cooled and solidified to form rock.
RS	**River Sediments** Silt, gravel and sand bars associated with former river channels and present river edges.
ES	**Exposed Soil** Any exposed soil not covered by other categories such as areas of recent disturbance that include mud slides, debris torrents, avalanches, or disturbances such as pipeline rights-of-way where vegetation cover is less than five percent.
LS	**Pond or Lake Sediments** Exposed sediments related to dried lakes or ponds.
RM	**Reservoir Margin** Land exposed by a drained or fluctuating reservoir. This is found above "normal" water levels and may consist of a range of substrates including gravel, cobbles, fine sediments, or bedrock.
BE	**Beach** An area with sorted sediments reworked in recent time by wave action which may be formed at the edge of fresh or salt water bodies
LL	**Landing** A compacted area adjacent to a road used for the purpose of sorting and loading logs.

CODES	DESCRIPTION
BU	**Burned Area** Land showing evidence of recent burning, either natural or prescribed. Vegetation of less than 5% crown cover is present at the time of polygon description.
RZ	**Road Surface** An area cleared and compacted for transporting goods and services by vehicles. Older roads that are used infrequently or not at all may cease to be non-vegetated.
MU	**Mudflat Sediment** Flat plain-like areas associated with lakes, ponds, rivers or streams - dominated by fine textured sediments. They can be associated with freshwater or estuarine sources.
CB	**Cutbank** Part of a road corridor created up slope of the road surface created by excavation into the hillside.
MN	**Moraine** An area of debris transported and deposited by a glacier.
GP	**Gravel Pit** An area exposed through the removal of sand and gravel.
TZ	**Tailings** An area containing the solid waste material produced in the mining and milling of ore.
RN	**Railway** A roadbed with fixed rails which may contain single or multiple rail lines.
UR	**Urban** Buildings and associated developments such as roads and parking areas which form an almost continuous covering of the landscape.
AP	**Airport** A permanent, paved or gravel area, and associated buildings and parking, used by airplanes.
MI	**Open Pit Mine** An exposed area used to extract ore during a mining operation. This may contain associated buildings and any tailing produced by the mining and milling process.
OT	**Other** A non-vegetated polygon where none of the above categories can be reliably chosen.
	Water Cover
LA	**Lake** A naturally occurring static body of water more than two metres deep in some portion. The boundary for the lake is the natural high water mark.
RE	**Reservoir** An artificial basin affected by impoundment behind a man made structure such as a dam, berm, dyke, or wall.

CODES	DESCRIPTION
RI	**River/Stream** A water course formed when water flows between continuous, definable banks. Flow may be intermittent or perennial but does not include ephemeral flow where a channel with no definable banks is present. Gravel bars are part of a stream while islands within a stream that have definable banks are not.
OC	**Ocean** A naturally occurring body of water containing salt or generally considered to be salty.

Note that the level 4 non-vegetated cover type codes (SI-Snow/Ice, RO-Rock/Rubble and EL-Exposed Land) have been removed from Table 10.1 as they are no longer acceptable for this attribute.

10.2 Non-Vegetated Cover Percent

Definition

Non-vegetated cover percent indicates the percentage of the polygon area that is occupied by a non-vegetated cover.

Purpose

Non-vegetated cover percent provides a direct estimate of non-vegetated cover which is not adjusted.

Procedure

Estimate non-vegetated cover percent, based on the percentage of ground area of the polygon covered by the non-vegetated cover type (see Figure 10-2). Enter the cover percent estimate on the same line of the attribute form as the cover type.

Enter the non-vegetated cover percent for each non-vegetated cover type identified in the polygon. There are no constraints to the number of non-vegetated cover types that can be identified.

Example of Non-Vegetated Cover Percent

The following example (see Figure 10-1) shows a polygon with coniferous tree cover (the land cover component is indicated as being entirely treed) and there is non-vegetated (river sediment) cover of four percent.

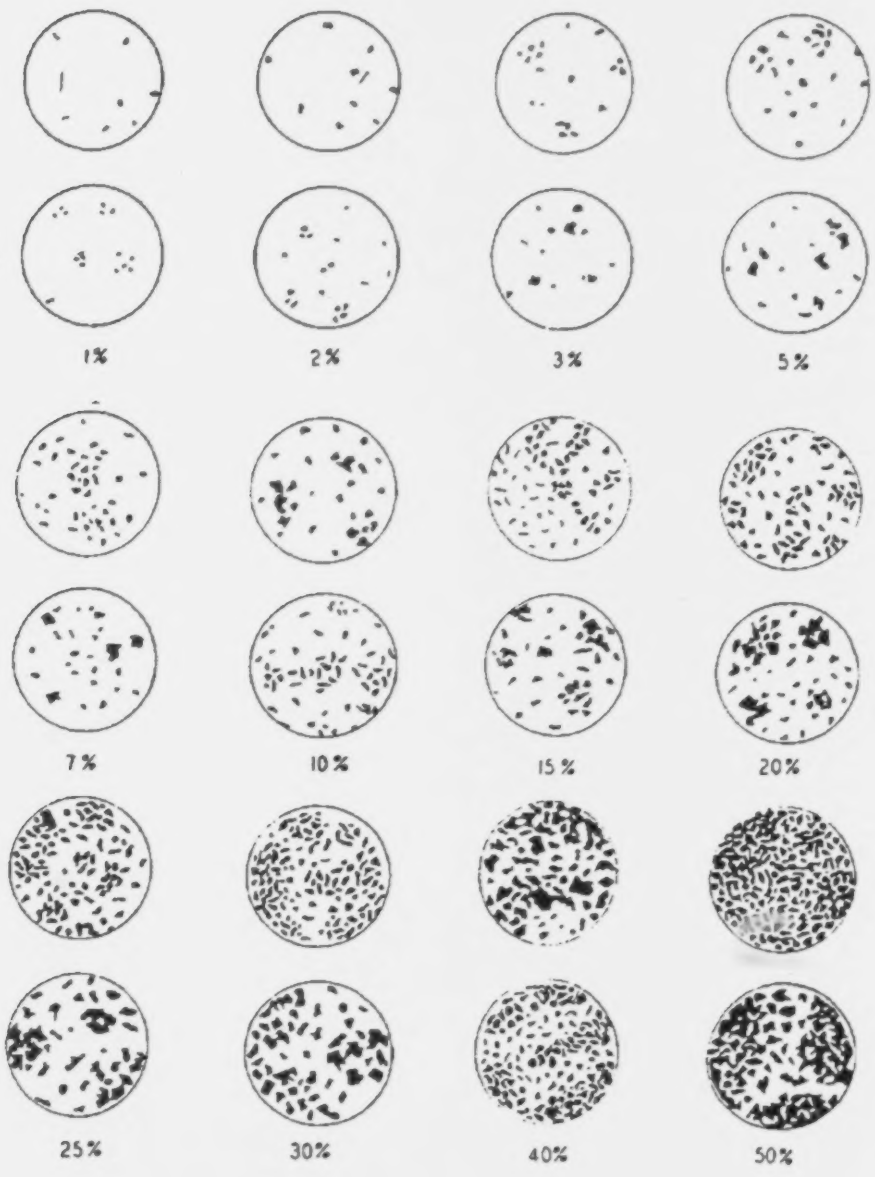
Land Cover Component #1 = TC 100%

Non-Vegetated Cover = RS

Non-Vegetated Cover Percent = 4%

All of tree information is recorded in the Tree Specific Data of the Attribute Form or database. The Non-Vegetated Cover Type is entered as "RS" and the Non-Vegetated Cover Percent is entered as "004".

Figure 10.1 – Example of Non-Vegetated Cover Percent



Developed by Richard D. Terry and George V. Chillinger. Published by the Society of Economic Paleontologist and Minerologist in its journal of Sedimentary Petrology 25(3): 229 - 234, September 1955.

Comparison charts for Visual Estimation of Foliage Cover.

Figure 10.2 – Comparison Chart for estimating cover percent.

10.3 Non-Vegetated Cover Pattern

Definition

Non-vegetated cover pattern describes the spatial distribution of the non-vegetated cover types within the polygon. Each non-vegetated cover type indicated must have a non-vegetated cover pattern assigned.

Purpose

Non-vegetated cover pattern is used to describe non-vegetated cover spatial distribution. Examples include roads within vegetated polygons or lakes within non-vegetated polygons.

Procedure

Enter the cover pattern code (1-9), for each non-vegetated cover type identified in the polygon, from Figure 10-3.

There are no constraints on the number of non-vegetated cover types to be identified.

1. Single to very few (<4) occurrences of limited extent, circular to irregular shape.
2. Single to very few (<4) occurrences of limited extent, linear or elongated shape.
3. Several (>3) sporadic occurrences of limited extent, circular to irregular shape.
4. Several (>3) sporadic occurrences of limited extent, linear or elongated shape.
5. Intimately intermixed units, often with gradational transitions from one to the other.
6. Discontinuous but extensive occurrences, parallel to sub-parallel elongated in shape.
7. Limited continuous occurrence with few inclusions.
8. Continuous occurrence with several inclusions.
9. Continuous occurrence with very few inclusions.

Figure 10.3 – Non-Vegetated cover patterns.

Section 11:
Derived Polygon Attributes

Introduction

Photo interpreters delineate and assign many attributes to polygons on mid-scale aerial photographs that describe the land base and vegetation characteristics. A number of additional attributes can be derived, in a consistent manner, from the estimated attributes. For example, the tree cover site index can be derived from the estimates for species, age, and height. Similarly, the land cover class code can be derived from the landscape position, vegetation type, and crown closure estimates.

This section presents a discussion of the additional attributes, referred to as "derived attributes," that have been identified as a product of Photo Interpretation phase of the Vegetation Resources Inventory. While the provision of these estimates is not the immediate task of the photo interpreter, it is important that their derivations and the associations with the photo-interpreted attributes are understood.

In this respect, photo interpreters are encouraged to consider the extension of the Photo-interpreted information being provided.

The following list presents the attributes identified for derivation from the photo-interpreted attributes that may be subsequently adjusted with Ground Sampling data:

- land cover class code;
- dominant polygon soil moisture regime (SMR);
- tree diameter at breast height (DBH);
- tree volume;
- tree site index;
- polygon descriptions for multi-layered stands;
- slope, aspect and elevation

11.1 Land Cover Class Code

Definition

The land cover class code is the land cover designation of the polygon, consistent with the B.C. Land Cover Classification Scheme.

Purpose

The land cover class code provides a categorization of the polygon to the most detailed land cover description level of the B.C. Land Cover Classification Scheme. This information can be used for the classification of individual polygons and can be summarized for national and international reporting.

Derivation Procedure

The five levels of the B.C. Land Cover Classification Scheme can be derived from the photo interpreter's estimates as follows. (See Section 1: *B.C. Land Cover Classification Scheme* for a detailed description of the levels.)

Vegetated

Level 1 Land base - Vegetated versus Non-Vegetated

Level 1 is derived from the sum of the vegetation crown closures.

Level 2 Land cover type (Treed versus Non-Treed)

Level 2 is derived from the tree crown closure estimate.

Level 3 Landscape Position (Wetland, Upland or Alpine)

The Alpine designation indicates polygons that fall in the alpine regions of the landscape. For all other polygons, land cover component #1 soil moisture regime will determine whether that polygon is considered to be Upland or Wetland. The B.C. Land Cover Classification Scheme presents the designations "Wetland, Upland, and Alpine" as being mutually exclusive; however, it is possible in some rare cases to have a wetland polygon in an alpine setting. The current format of the scheme is maintained due to the infrequency of this occurrence.

Level 4 Vegetation Type

An iterative process following the rules of the B.C. Land Cover Classification Scheme is followed using the hierarchy of the Scheme. If the polygon is Treed, the basal area of each species (expressed as percent composition) is reviewed and amalgamated to determine which vegetation type the polygon should be classified as. If the polygon is Non-Treed, the hierarchy of the Scheme is implemented to determine which vegetation type should be derived.

Level 5 Density

Level 5 is derived from specific vegetation type crown closure (or cover percent for Herb and Bryoid cover types).

Non - Vegetated

Level 1 Land base - Vegetated versus Non-Vegetated

Level 1 is derived from the sum of the vegetation crown closures.

Level 2 Land Cover Type

Level 2 is derived using the Level 5 information and working in reverse order. Each non-vegetated category can be directly correlated with a specific land cover type.

Level 3 Landscape Position

The Alpine designation indicates polygons that fall in the alpine regions of the landscape. For all other polygons, land cover component #1 soil moisture regime will determine whether that polygon is considered to be Upland or Wetland. The B.C. Land Cover Classification Scheme presents the designations "Wetland, Upland and Alpine" as being mutually exclusive; however, it is possible in some rare cases to have a wetland polygon in an alpine setting. The current format of the scheme is maintained due to the infrequency of this occurrence.

Level 4 Non-Vegetated Cover Type

Level 4 is derived using the level 5 information and working in reverse order. There is a direct correlation between each Non-Vegetated category and a specific Non-Vegetated cover type. No level 4 codes exist for water bodies, therefore these fields are left blank for Water cover types.

Level 5 Non-Vegetated Categories

The codes from level 5 will be assigned directly by the photo interpreter as part of the attribute estimation process.

Examples:

A typical derivation of a Vegetated Land Cover Class Code:

Level	Estimated attribute criteria	Code
1	Vegetated crown closure $\geq$5%	V
2	tree crown closure $\geq$10%	T
3	not Alpine LCC #1 SMR = 4	U
4	species composition = Pl80At20	TC
5	tree crown closure = 80%	DE

The Land Class Code for this polygon would be "VTUTCDE".

An example of a derivation of a Non-Vegetated Land Cover Class Code:

Level	Estimated attribute criteria	Code
1	Vegetated crown closure <5%	N
2	level 5 = Rubble, Talus, Blockfield	L
3	Alpine	A
4	level 5 = Rubble, Talus, Blockfield	RO
5	photo estimated as 'Talus'	TA

The Land Class Code for this polygon would be "NLARORT".

11.2 Dominant Polygon Soil Moisture Regime

Definition

The dominant polygon soil moisture regime (SMR) is an estimate of the soil moisture for the polygon.

Purpose

Dominant polygon SMR provides soil moisture information at the polygon level, thus facilitating broad reporting capabilities.

Derivation Procedure

Dominant polygon SMR is derived from the largest land cover component by area. If the first two or more land cover components are equal in percent area, the first land cover component indicated will be used to derive the dominant SMR.

11.3 Tree Diameter at Breast Height (DBH)

Definition

Diameter at breast height (DBH) is the average tree diameter at breast height for all live trees in the dominant, codominant, and high intermediate crown positions in each tree layer in the polygon.

Note: Dominant trees have well-developed crowns that extend above the general level of the trees around them. Codominant trees have crowns forming the general level of trees around them. High intermediate trees have smaller crowns slightly below but extending into the general level of trees around them.

Purpose

DBH provides an additional dimension of tree stand information that is useful for broad silviculture planning (particularly for lower productivity, interior lodgepole pine stands) as well as change management of some forest stands.

Derivation Procedure

DBH of the visible trees can be derived from the estimates provided for basal area per hectare and density using the following method:

$$DBH = 2 * \sqrt{\text{Basal Area} / (\text{Density} \times p)}$$

Example: Basal Area = 100 m^2 per hectare

Density = 400 stems per hectare

$$DBH = 2 * \sqrt{\frac{100 m^2 \, per ha}{400 stems \, per ha \, x \, 3.14}}$$

$$= 2 * \sqrt{0.0796 m^2}$$

$$= 0.564 \text{ m}$$

$$= 56.4 \text{ cm DBH}$$

11.4 Tree Volume

Definition

Volume is the average gross stem volume of all living trees visible to the photo interpreter for the polygon, expressed in cubic metres per hectare.

Purpose

The derivation of volume estimates for each polygon provides another method of assessing timber yields and can be useful for long-term resource planning.

Derivation Procedure

Volume can be derived from estimates provided for basal area, species composition, and height. Leading species and the vegetation inventory project location (e.g., Forest Inventory Zone) determines which taper equations and which decay, loss, and breakage factors are appropriate for volume derivation. Basal area and height then provide the essential input parameters from which volume estimates can be derived.

A very simplified formula to calculate tree volume is:

Gross volume = 1/3 x height x basal area

If basal area = 57 m^2 per ha and height = 42 m

Gross volume = 1/3 x 42 m x 57 m^2 per ha

Gross volume = 798 m^3 per ha

This is a simplified approach for demonstration purposes only. The actual process and formula used to derive the volume that will be stored in the database will incorporate many more factors than the formula indicated above.

11.5 Tree Site Index

Definition

Site index is an estimate of site productivity for tree growth, expressed as a height (in metres) at breast height age of 50 years for a particular tree species.

Purpose

Site index provides an estimate of the site productivity for tree species growth.

Derivation Procedure

Site index estimates are required on all treed polygons as well as polygons that are potentially capable of producing trees. Stands that are 30 years or older will have the site index derived from species, age, and height. The photo interpreter can still override the process if they:

- have field data to provide site specific values; or,
- have evidence to indicate abnormal site suppression exists.

Leading species indicates which species height/age curves should be used. Age and height estimates then indicate which of the available curves should be used for extrapolation (age less than 50 years) or interpolation (age greater than 50 years) of site index.

11.6 Polygon Description for Multi-layered Stands

Definition

The polygon description for multi-layered stands is a summary of the attribute estimates for each observable tree layer into one set of attribute estimates for the polygon.

Purpose

Ground Sampling data does not differentiate trees from different layers within a stand. Therefore, attributes from individual tree layers need to be amalgamated into a single polygon description to facilitate inventory adjustments.

The adjustment is followed by a redistribution of the adjusted attribute values into the original individual tree layer estimates.

Derivation Procedure

Example:

The following is an example of an adjustment and redistribution into layers of a two-layered stand. Assume an adjustment ratio of 1.1 for all attribute adjustments. This indicates that all attribute values should be 10% higher as a result of the ground sampling phase.

Attribute layers	**Redistribution procedure into individual tree**
Species composition	Prorated on the basis of basal area
Crown closure	$\text{crown closure}_{(\text{layer 1})} + \text{crown closure}_{(\text{layer 2})} + \ldots + \text{crown closure}_{(\text{layer n})} = \text{polygon crown closure}$
Age	Prorated on the basis of basal area
Height	Prorated on the basis of basal area
Basal area	$\text{basal area}_{(1)} + \text{basal area}_{(2)} + \ldots + \text{basal area}_{(n)}$
Density	$\text{density}_{(1)} + \text{density}_{(2)} + \ldots + \text{density}_{(n)}$
Snags	$\text{snags}_{(1)} + \text{snags}_{(2)} + \ldots + \text{snags}_{(n)}$

Adjustment of the total polygon estimates takes place with computed adjustment ratios from the ground samples.

Table 11-1 shows the adjustment of a two-layer stand.

Table 11.1 – Adjustment of a two-layer stand

Attribute	Estimate Layer 1 (visible)	Estimate Layer 2 (visible)	Estimate Total for Polygon	Ground Sampling Adjusted Polygon Value	Adjusted Layer 1	Adjusted Layer 2
Age (years)	250 (x $\frac{24}{32}$)	50 (x $\frac{8}{32}$)	200 (x 1.1) =	220	265 (250 + ($\frac{24}{32}$) * 20)	55 (50 + ($\frac{8}{32}$) * 20)
Height (m)	33.0 (x $\frac{24}{32}$)	12 (x $\frac{8}{32}$)	27.9 (x 1.1) =	30.7	35.1 (33 + ($\frac{24}{32}$) * 2.8)	12.7 (12 + ($\frac{8}{32}$) * 2.8)
Basal area (m^2/ha)	24 sum	8	32 (x 1.1) =	35	26 (24 + ($\frac{24}{32}$) * 3)	9 (8 + ($\frac{8}{32}$) * 3)
Density (stems per ha)	100 sum	350	450 (x 1.1) =	495	110 (100 + ($\frac{100}{450}$) * 45)	385 (350 + ($\frac{350}{450}$) * 45)
Snags (stems per ha)	10 sum	0	10 (x 1.1) =	11	11 (10 + ($\frac{10}{10}$) * 1)	0 (0 + ($\frac{0}{10}$) * 1)

This is a simplified approach for demonstration purposes only.

11.7 Slope, Aspect, and Elevation

Definition

Slope is the average gradient of the polygon measured in percent. Aspect is the average oriented direction of the polygon measured in degrees azimuth. Elevation is the average height above mean sea level of the polygon measured in metres.

Purpose

Slope, aspect, and elevation contribute to a more complete description of the polygon and provide information useful for ecological interpretations.

Derivation Procedure

A Digital Elevation Model (DEM) provides the necessary information for GIS derivation for each slope, aspect, and elevation.

Glossary

Age of leading and second species: a weighted (by basal area) average age of the dominant, codominant, and high intermediate trees within each layer of the polygon for the leading and second tree species identified.

Alpine: the land area above the maximum elevation for tree species. It is dominated in the vegetated areas by shrubs, graminoids, forbs, bryoids or lichens. Much of the alpine is non-vegetated, covered primarily by rock, ice, and snow. The alpine is treeless by definition, however, there may be a few rare trees (1% crown closure or less).

Alpine designation: one category of landscape position in the third level of the B.C. Land Cover Classification Scheme. It is dominated in the vegetated areas by shrubs, graminoids, herbs, bryoids and lichens. Much of the alpine is non-vegetated, covered primarily by rock, ice and snow. The alpine is treeless by definition, however, there may be a few rare trees (1% crown closure or less).

Aspect: the average oriented direction of the polygon measured in degrees azimuth.

Attributes: polygon based estimates described by photo interpreters.

Basal area: the cross-sectional area (in square metres per hectare) of all living trees visible to the photo interpreter in the dominant, codominant and high intermediate crown positions in each tree layer in the polygon.

Bryoids: includes bryophytes (mosses, liverworts, hornworts) and non-crustose lichens.

Codominant trees: trees having crowns forming the general level of the trees around them.

Confidence index: a subjective value that reflects the confidence that the photo interpreter has in their estimation of age, height and basal area.

Data source: identifies the primary source of information used to determine the attribute or attributes being described.

Density: the average number of living trees in the polygon visible to the photo interpreter in the dominant, codominant and high intermediate crown positions in each tree layer in the polygon. It is expressed as a per hectare value.

Derived attributes: land cover descriptions that are generated from the estimates of other land cover values.

Dominant trees: trees having well-developed crowns that extend above the general level of the trees around them.

Elevation: the average height above mean sea level of the polygon, measured in metres.

Estimated site index: an estimate of site productivity for tree growth indicated as the height, in metres, at breast height age 50 years.

Estimated site index source: source of information or method used for site index determination.

Estimated site index species: tree species upon which the site index is based.

Forbs: herbaceous plants other than graminoids; including ferns, clubmosses and horsetails.

General polygon attributes: includes assigned attributes and estimated attributes (polygon number, data source, surface expression, modifying processes, site position meso, alpine designation and soil nutrient regime).

Generalized SMR/SNR: a grouping of SMRs/SNRs into broader classes. The differentiation of SMRs/SNRs between these classes is more critical than the differentiation of SMRs/SNRs within each class.

Graminoids: herbaceous plants with long, narrow leaves characterized by linear venation; including grasses, sedges, rushes and other related plants.

Height of leading and second species: the average height of the dominant, codominant and high intermediate trees, weighted by basal area, for the leading and second tree species for each tree layer identified.

Herbs: non-woody plants, including graminoids (sedges, rushes, grasses, and grass-like plants), vascular cryptogams (ferns, fern allies, club mosses and horsetails) and some dwarf woody species and intermediate life forms listed in Table 4-1 of *Describing Ecosystems in the Field,* MOE Manual 11 (Luttmerding et al. 1990).

Herb cover pattern: describes the spatial distribution of herbaceous cover within the polygon.

High intermediate trees: trees having smaller crowns, slightly below but extending into the general level of the trees around them.

Krummholz: the scrubby, stunted growth form of trees, often forming a characteristic zone at the limit of tree growth at high elevations (from *Forest Ecology Terms in Canada, Canadian Forest Service, 1994*).

Land Base: the first level of the B.C. Land Cover Classification Scheme. This classifies the polygon as Vegetated, Non-Vegetated or Unreported. The presence or absence of vegetation is recognized by the vertical projection of vegetation upon the land base within the polygon.

Land Cover Classification Scheme: refers to the B.C. Land Cover Classification Scheme which forms Section 1 of this procedures document. It is derived from the original Vegetation Resources Inventory document *B.C. Land Cover Classification Scheme*, March, 1999.

Land cover component: identifies a type of land cover, under the B.C. Land Cover Classification Scheme, to the most detailed level possible. They consist of continuous areas within the polygon that are individually 10% or more of the polygon area, and would otherwise be delineated and classified at approximately twice the map scale.

Land cover component percent: the area, as a percentage of the polygon, occupied by each land cover component.

Land cover type: the second level of the B.C. Land Cover Classification Scheme. This classifies the polygon as Treed or Non-Treed; Land or Water.

Landscape position: the third level of the B.C. Land Cover Classification Scheme. This classifies the polygon as Alpine, Wetland or Upland.

Minimum polygon size: to be set by contract supervisor as local user needs are identified. Suggested minimum sizes are 2 hectares for areas with distinct boundaries and 5 hectares for area with indistinct boundaries.

Modifying processes: natural mechanisms of weathering, erosion and deposition that result in the modification of surficial materials and land forms at the earth's surface. It is described by letter codes that include descriptions of avalanching, river channeling, mass movements, flooding, and gully erosion.

Multi-layered stand: a polygon that has more than one distinctly recognizable height layer and may be considered the same as a site occupied by more than one distinct single-layered stand.

Non-Treed polygon: a polygon is considered Non-Treed if less than 10% by crown cover of the polygon area consists of tree species of any size.

Non-vegetated categories: the fifth level of the B.C. Land Cover Classification Scheme. This classifies the polygon into one of a number of specific categories of Non-Vegetated cover.

Non-Vegetated cover types: the fourth level of the B.C. Land Cover Classification Scheme. This classifies the polygon as Snow / Ice, Rock / Rubble or Exposed Land if Non-Vegetated. The Non-Vegetated cover type is left blank for water features.

Non-Vegetated polygon: a polygon is considered Non-Vegetated when the total cover of trees, shrubs, herbs, and bryoids (other than crustose lichens) covers less than 5% of the surface area of the polygon. Bodies of water are included in this class.

Parkland: a landscape characterized by strong clumping of trees due to environmental factors (from *Ecosystems of British Columbia, MoF, 1991*).

Phase I: refers to the Provincial Vegetation Resources Inventory process involving photo estimation of detailed land cover attributes. Also referred to as Photo Interpretation.

Phase II: refers to the Provincial Vegetation Resources Inventory process involving ground sampling of polygon attributes. Data gathered is used to adjust Phase I estimates. Also referred to as Ground Sampling.

Polygon: a portion of land area delineated on mid-scale aerial photography of "like" or uniform land cover appropriate for applying land cover descriptions.

Polygon delineation: the process of dividing the landscape into uniform polygons according to defined criteria.

Polygon number: a unique number assigned to each polygon after it has been delineated.

Shrubs: multi-stemmed or non-erect woody plant species that do not include species previously defined as trees or those dwarf woody plants and intermediate life forms listed in Table 4-1 of *Describing Ecosystems in the Field*, MOE Manual 11.

Shrub cover pattern: describes the spatial distribution of shrubs within the polygon.

Shrub crown closure: the percentage of ground area covered by the vertically projected crowns of shrubs; expressed as a percentage of the entire polygon.

Shrub height: the average height, in tenths of a metre, of all shrubs within the polygon.

Site position meso: indicates the relative position of the polygon within a catchment area. An alphabetic code indicates crest, upper slope, middle slope, lower slope, toe, depression or flat site position.

Slope: the average gradient of the polygon expressed as a percentage.

Snag frequency: the number of standing dead trees visible to the photo interpreter in the dominant, codominant and high intermediate crown positions. It is expressed as a per hectare value for each tree layer in the polygon.

Soil nutrient regime (SNR): refers to the amount of essential soil nutrients, particularly nitrogen, available to vascular plants over a period of several years. SNR classes include A (very poor), B (poor), C (medium), D (rich), E (very rich) and F (ultra rich, saline).

Soil moisture regime (SMR): refers to the average amount of soil water annually available for evapotranspiration by vascular plants over several years. SMR classes include 0 (very xeric), 1 (xeric), 2 (subxeric), 3 (submesic), 4 (mesic), 5 (subhygric), 6 (hygric), 7 (subhydric) and 8 (hydric).

Species composition: identifies the tree species in the polygon and provides an estimate of the percentage of each species present.

Stand structure: indicates the distribution and representation of different stand ages and stand size classes within a polygon.

Surface expression: describes the form and patterns of form of the surficial material within the polygon. It is described by letter codes that indicate the following forms: cone, depression, fan, hummock, rolling, plain, ridge, terrace, undulating, or none of the above.

Top height: the height of a stand of trees as measured or estimated using "top height" procedures. Currently this is the height of the tree with the largest diameter at breast height within a 5.64 metre fixed-radius plot.

Tree cover pattern: describes the spatial distribution of the tree cover within each tree layer in the polygon.

Tree crown closure: the percentage of ground area covered by the vertically projected crowns of the tree cover for each tree layer in the polygon.

Tree layer: a number that identifies the tree layer being described in a multi-layered stand.

Treed polygon: a vegetated polygon is considered Treed if 10% or more of the polygon by crown cover consists of tree species of any size.

Update year: the year, after year of photography, that an update or revision has occurred to the age or height of the leading tree species layer in the polygon.

Upland designation: a broad class that includes all non-wetland ecosystems below the Alpine that range from very xeric, moss- and lichen-covered rock outcrops to highly productive forest ecosystems on hygric (SMR 6) soils.

Variable Density Yield Prediction (VDYP): a method, based on empirical data, of calculating mensurational data (primarily stand volume and tree diameter) from photo-interpreted data (such as species composition, age, height, crown closure).

Vegetated polygon: a polygon is considered Vegetated when the total cover of trees, shrubs, herbs, and bryoids (other than crustose lichens) covers at least 5% of the total surface area of the polygon.

Vegetation cover types: the fourth level of the B.C. Land Cover Classification Scheme. This classifies the polygon as Coniferous, Broadleaf or Mixed if treed; as Tall Shrub or Low Shrub if shrub cover; undifferentiated Herbs, Forbs or Graminoids if herb cover; and undifferentiated Bryoids, Moss or Lichens if cover is bryoids.

Vegetated density classes: the fifth level of the B.C. Land Cover Classification Scheme. This classifies the polygon as Dense, Open or Sparse for tree, shrub and herb covers; and classes the polygon as Closed or Open for bryoid cover.

Vertical complexity: a subjective classification that describes the form of each tree layer as indicated by the relative uniformity of the forest canopy as it appears on mid scale aerial photographs.

Volume: average gross stem volume of all living trees in the dominant, codominant and high intermediate crown positions. It is expressed in cubic metres per hectare.

Wetland designation: land having the water table near, at, or above the soil surface, or which is saturated for a long enough period to promote wetland or aquatic processes. These processes are indicated by poorly drained soils, specialized vegetation, and various kinds of biological activity which are adapted to the wet environment.